Request for Decision

Red Light Camera Program

Presented To:	Finance and Administration Committee
Presented:	Tuesday, Jul 10, 2018
Report Date	Wednesday, Jun 27, 2018
Type:	Referred & Deferred Matters

Resolution

THAT the City of Greater Sudbury approves the implementation of a Red Light Camera (RLC) Program as outlined in the report entitled "Red Light Program", from the General Manager of Growth and Infrastructure, presented at the Finance and Administration Committee meeting on July 10, 2018;

AND THAT staff be directed to request inclusion in the Ontario RLC consortium of municipalities so that the City can benefit from the joint operating costs and administration of the program;

AND THAT staff be authorized to enter into agreements with the City of Toronto and the Ministry of the Attorney General and Ministry of Transportation to allow the RLC project to come into effect;

AND THAT city staff be authorized to undertake all administrative acts that are necessary in connection with this project;

AND THAT additional field work is performed by Aecom to bring the number of recommended sites for an RLC from three to six;

AND THAT staff report back to the Finance and Administration Committee as part of the 2019 budget process with an updated business case and a status report on the RLC project and anticipated timeline for implementation.

Signed By

Report Prepared By
Joe Rocca
Traffic and Asset Management Supervisor
Digitally Signed Jun 27, 18

Manager Review
Joe Rocca
Traffic and Asset Management Supervisor
Digitally Signed Jun 27, 18

Division Review
Stephen Holmes
Director of Infrastructure Capital Planning
Digitally Signed Jun 27, 18

Financial Implications
Jim Lister
Manager of Financial Planning and Budgeting
Digitally Signed Jun 27, 18

Recommended by the Department
Tony Cecutti
General Manager of Growth and Infrastructure
Digitally Signed Jun 27, 18

Recommended by the C.A.O.
Ed Archer
Chief Administrative Officer
Digitally Signed Jun 27, 18

Relationship to the Strategic Plan / Health Impact Assessment

This report recommends the use of red light cameras (RLCs) at six City intersections with the goal of providing safer City roads as the effectiveness of RLC's can be measured by reductions in crash frequency and crash severity. This

advances the City's strategic priority of improving the health and well being of City residents.

Report Summary

Red light running has been identified as the 6th highest target area causing injury or fatal collision and it was indentified for targeted safety programs in the City's Road Safety Assessment. RLCs have been proven effective in other Ontario municipalities at reducing the number of red light running and thereby the number of associated collisions.

Staff is proposing to implement 6 red light cameras, three of which have been identified as part of an AECOM study of city intersections, with three others to be identified through additional field work.

Financial Implications

It is anticipated for Greater Sudbury that six RLC's will produce a net positive financial benefit which can be used to implement safety measures to improve road safety but more importantly, will also create positive societal benefits.

Additional field work is required to identify three additional intersections that would benefit from an RLC that will be funded from existing Roads capital account for consultants.

Staff will report back to Council as part of the 2019 budget process with an updated business case and a status report on the anticipated timeline for RLC implementation.

Background

The Traffic and Asset Management section recently completed a city wide Road Safety Assessment (RSA). The overall objective of the RSA is the development of a coordinated road safety strategy plan that provides direction for future road safety projects and programs with a primary goal of reducing the number and severity of motor vehicle collisions.

As part of the RSA, motor vehicle collisions data was analyzed based on injury and fatal collision occurrence in order to identify potential causes and solutions with respect to road safety strategies. In the analysis, it was identified that red-light running was a contributor to causing serious collisions and it was further identified for targeted safety programs.

Intersection safety is achieved through a combination of engineering, education and enforcement. A Red Light Camera program (RLC) is one of the countermeasures utilized to improve intersection safety by decreasing the incidence of red light running at intersections.

Collisions resulting from red-light running tend to be more severe than other intersection collisions because they usually involve at least one vehicle travelling very quickly. In the most serious red-light running collisions, the vehicles hit each other at right angles. The resulting side-impact collisions cause severe injuries which sometimes lead to death.

RLCs were first introduced in Ontario in 2000 and eight municipalities operate over 190 RLC sites. These would include Toronto, London, Ottawa, Hamilton and the Regions of Peel, Waterloo, York and Halton.

The following summarizes what a RLC program is, how it could be implemented in Greater Sudbury, and outlines the next steps if a RLC program is to be implemented.

Analysis

RLCs are triggered when a vehicle enters an intersection on a red light. Two images of the vehicle are taken and processed. If the images clearly show a red light violation then an infraction notice is mailed to the registered owner of the vehicle. Similar to parking tickets, RLC violations are the responsibility of the vehicle owner, and there are no demerit points involved.

Red-light cameras photograph a vehicle's rear license plate only; not its driver or occupants. The RLC programs in Ontario have consulted the Province's Information and Privacy Commissioner to ensure the cameras do not violate driver privacy.

The effectiveness of red light cameras can be measured in terms of reductions in crash frequency, crash severity, and frequency of red light running violations.

RLCs can reduce the frequency of angle collisions, usually the most severe type of collision, by 25%. However, RLCs can increase the number of rear-end collisions by an

estimated 15%. Typically angle collisions are more severe then rear end collisions, therefore there is an overall net safety improvement and a positive overall safety cost benefit. Public awareness of RLCs also reduces aggressive driver behaviour.

A red light camera before-and-after study released in 2011 found that in 14 U.S. cities with red light cameras, fatalities due to red light running declined by 35%.

Ontario municipalities that have installed RLCs have seen the numbers of red-light running infractions decrease and the number of rear end collisions decrease over time as motorists become accustomed to the RLC's and that these benefits have extended to other intersections that do not have RLCs.

In general, the presence of automated enforcement on a 24/7 basis provides a strong deterrent. For RLCs in particular, public acceptance in municipalities has been high because the act of running a red light is recognized as one which is reckless and can easily have severe consequences.

The financial penalty in the Province of Ontario is the same for a red light running violation issued by a RLC system or by a police officer. Red light camera evidence is also well accepted in Ontario Courts and to date there has been no successful challenge of a red light running violation based on evidence from a red light camera system. The current fine for a red light running violation is $325. Of this $325, the municipality retains $265 while $60 is sent to the Province through the victim surcharge fine. If the fine goes unpaid, the license plate cannot be renewed. The owner's driver's license is not suspended and no jail term can be imposed for defaulting on the payment of the fine.

Potential RLC Locations Within CGS

Similar to other municipalities in Ontario that have red light programs, CGS commissioned a study to assess the need for implementing a red light program and to identify sites which would benefit the most from the deployment of the RLCs. The study was performed by AECOM and their report is under separate cover. The goal was to identify intersections where an RLC was the best engineering solution to minimize right angle collisions. This strategy is in line with the City's goal to facilitate a safe and efficient road network.

It is recommended that six RLCs be introduces within CGS in those intersections that will have the largest impact on minimizing collisions as well of modifying driver behaviour on red light running.

Of the City's 124 signalized intersections, AECOM identified seven intersections as possible candidates to install a RLC to minimize right angle collisions. After a field review of those intersections, it was determined that four intersections would benefit from other measures, i.e. improved signage, branch removal therefore RLCs were not considered as the best choice. For the remaining three intersections, a RLC is being recommended as the best solution to minimize/improve collision rates. These intersections are:

- Paris Street at Cedar Street
- Regent Street at Algonquin Road
- Municipal Road 80 at Dominion Drive

It is further recommended that field work continue on other intersections within the CGS where collision rates are greater than expected and identify an additional three intersections where a RLC is recommended as the best traffic solution to reduce collisions. Once selected, the recommended six locations will be brought forward to Council for approval.

Red Light Camera Program Implementation

Implementation of a RLC program involves many steps and various approval processes which are outlined below:

1. Receive initial approval for the RLC program from City Council.
2. Request membership with the existing Ontario RLC group of municipalities so that Greater Sudbury can benefit from the joint operating costs and administration of the program.
3. Report back to Council as part of 2019 budget with an updated business case and status of the project.
4. Develop an internal team to implement the program that would be led by the Traffic and Asset Management section and include staff from Finance, Police, Communications, Legal and Provincial Court Administration.
5. Adoption by City Council of the RLC locations and apply to have the Highway Traffic Act regulations amended to include these locations. All RLC sites in Ontario must be listed in the Highway Traffic Act.
6. Enter into an agreement with the City of Toronto for the processing of the RLC infractions, after it obtains permission from their Council. Toronto currently processes all RLC infractions in Ontario.
7. Enter into a RLC contract with the current vendor (Traffipax) for RLC leasings, installation, and maintenance and obtain confirmation from the camera vendor on site suitability.
8. Obtain the approval of the Ministry of the Attorney General to join the RLC program.
9. Enter into an agreement with Ministry of Transportation to obtain license plate and ownership information and sharing of data from the RLC program.
10. Development of a red-light running educational campaign to be implemented concurrently with the RLC program.

Based on data gathered from other municipalities, it is anticipated that the above steps would take 24 months to complete the various approvals.

Financial Implications

As stated, the implementation of an RLC program will involve entering into a contract with the current vendor for leasing and installing RLCs in Ontario. Based on the experience of other municipalities, the estimated costs, both fixed and variable will be approximately $60,000 per year per camera site. The following is a description of the cost components of a RLC program and the estimated costs based on 6 RLC sites.

Cost Component	**Description**	**Estimated Annual Cost**
RLC Contract	The RLC vendor is responsible for the purchase, installation and maintenance of the RLC's. The RLC vendor is responsible for the secure delivery of the digital images from the camera to the City of Toronto processing centre.	$25,000/site = $150,000
RLC Processing	Done by the City of Toronto. Toronto's Provincial Offences Officers review each RLC image and make the determination if a red light violation occurred. If a violation occurred, the processing centre mails the violation notice with two images to the registered owner of the vehicle.	Cost is variable based on number of violations. Estimated $130,000
Vehicle License Information	The vehicle's registered owner's name and address are required which is obtained from the Ontario Ministry of Transportation.	Cost is variable based on number of violations. Estimated $5,000
Provincial Court Administration	These costs are incurred for processing of the violation payments and the dispute resolution process. Based on the experience of other Ontario municipalities, the number of RLC violation trials is low.	Cost is variable based on number of violations. Estimated $75,000
Additional City Resources	An additional staff person will be required in the Roads division to manage the program including reports to the Province, evaluating the performance of the program, implementing the education component and developing other intersection safety initiatives.	$100,000
Education and Awareness	This program will include education and awareness measures to modify driver's behavior.	$40,000
Estimated Net Annual Cost		**$500,000**

A successful conviction of a RLC violation results in a fine of $325, of which $60 is designated as the victim surcharge, therefore the city would receive $265. The analysis below estimates conservatively that if there is one violation per day at each of the 6 sites, the estimated gross revenue would be $580,000 per year or $80,000 in net revenue. If there are two violations per day per camera site, estimated net revenue to the municipality would be $450,000. The analysis is summarized in the following chart.

	1 conviction/site/day	2 convictions/site/day
Revenue	$580,000	$1,160,000
Expenses	($500,000)	($710,000)
Net Revenue	$80,000	$450,000

It is recommended that if a RLC program is implemented that any surplus from the RLC program be committed to implement safety measures to improve road safety or to rehabilitate roads with a correlation with road safety (i.e pothole repairs).

Over time, it is anticipated that the number of right angle collisions at these intersections will decrease which has an associated social cost; however, it is also anticipated that the fine revenue will also decrease as there is improved compliance with red lights.

Societal Benefits

It is worth noting that the above business case simply projects the expected fine revenue against the operational costs of the program. A second method to measure the benefits of an RLC program is the societal benefits from expected collision reduction. Societal cost savings result from a reduction in fatalities and injuries, reduced property damage, a reduced burden on the health care system and on emergency services. There would also be a reduction in pain and trauma which cannot be measured.

Summary

Red light running has been identified as the 6th highest target area in Ontario for causing injury or fatal collision and it was indentified for targeted safety programs in the City's Road Safety Assessment. RLCs have been proven effective in other Ontario municipalities at reducing the number of red light running and thereby the number of associated collisions.

Staff is proposing to implement six red light cameras, three of which have been identified as part of an AECOM study of city intersections, with three others to be identified through additional field work.

It is anticipated for Greater Sudbury that six RLCs will produce a net positive financial benefit but more importantly, will provide positive societal benefits.

Throughout the balance of 2018, staff is proposing that the City request inclusion in the Ontario RLC consortium of municipalities so that the City can benefit from the joint operating costs and administration of the program. In addition, staff is proposing that authority be granted to begin the process to enter into required agreements with the City of Toronto Processing Centre, the Ministries of Transportation and Attorney General and the current red light camera vendor for leasing, installation and maintenance and to obtain confirmation from the vendor on site suitability.

Staff will report back to Council as part of the 2019 budget process with an updated business case and a status report on the anticipated timeline for RLC implementation.

Red Light Camera Program – Supplemental Report

Background:

The report entitled "Red Light Camera Program" was presented at the June 19, 2018 Finance and Administration Committee meeting. At the meeting, the committee asked staff to seek out additional information and report back at the next committee meeting. This report provides the additional information that was requested.

Emergency Services

There were several questions raised at the committee meeting regarding the potential of emergency vehicles receiving red light camera tickets for driving through a red light. The Ontario Highway Traffic Act ("HTA") does not provide an exception to emergency vehicles approaching a red light at a traffic signal and it requires that all emergency vehicles come to a complete stop prior to entering the intersection. Specifically, Section 144 of the HTA states:

> (18) Every driver approaching a traffic control signal showing a circular red indication and facing the indication shall stop his or her vehicle and shall not proceed until a green indication is shown.
>
> (20) Despite subsection (18), a driver of an emergency vehicle, after stopping the vehicle, may proceed without a green indication being shown if it is safe to do so.

City of Greater Sudbury Emergency Services staff is required to obey the HTA and come to a complete stop at a red light prior to proceeding through an intersection. This legislated requirement reduces the risk of collision while on route to an emergency call.

It should be noted, the probability of an emergency vehicle being required to stop at a traffic signal unnecessarily is reduced by the way traffic signals are programmed within the City. By default, traffic signals remain green on the main street if no vehicles or pedestrians waiting to cross the main street are detected and red light camera systems are typically deployed on a main street approach.

The committee also asked how many tickets are being issued to emergency services vehicles throughout the province. Staff was unable to find any municipal reports providing this statistic; however, there were several news articles which provided some information. A summary of the articles is provided below:

Toronto

An October 2015 CTV news article states that over an 18 month period (January 2014 to July 2015) there were 61 instances where Toronto police vehicles were captured going through a red light when they were not on an emergency call. The article does not state the total number of instances where a police vehicle was captured going through a red light and captured by a red light camera system. In 2014, the City of Toronto issued 45,394 red light camera tickets. If the 61 instances over an 18 month period are factored to consider a 12 month period instead, it would be expected that 41 tickets were issued to City of Toronto police vehicles during 2014. This represents 0.09% of all tickets issued.

City of Hamilton/Halton Region

A December 2015 news article in The Hamilton Spectator states that during 2015, 57 red light camera tickets (41 in the City of Hamilton, 16 in the Region of Halton) were issued to emergency services vehicles. A May 2012 news article in The Hamilton Spectator stated that in 2011, 49 red light camera tickets were issued to City of Hamilton emergency services vehicles. A May 2014 CBC News Article indicates that the City of Hamilton issued 15,569 red light camera tickets in 2013. Staff was unable to find any statistics on the total number of tickets issued in the Region of Halton.

If the number of tickets issued to City of Hamilton emergency vehicles is averaged per year and it is assumed the total number of tickets remained consistent, the 45 red light camera tickets issued per year to emergency services vehicles would represent 0.3% of the total annual red light camera tickets in the City of Hamilton.

If this percentage were applied to the assumptions made in the Red Light Camera Program report (1 conviction/site/day = 2,190 total convictions per year), it would be expected that 7 tickets per year would be issued to emergency services vehicles.

Ottawa

A May 2009 news article in the Ottawa Citizen states that more than 60 red light camera tickets were issued to emergency services vehicles in the past year. A June 2016 new article in the Ottawa Sun states that 17,658 red light camera tickets were issued in 2015. If the number of tickets issued to emergency services vehicles remained consistent from 2009 to 2015, it would represent 0.4% of the total annual red light camera tickets in the City of Ottawa.

If this percentage were applied to the assumptions made in the Red Light Camera Program report (1 conviction/site/day = 2,190 total convictions per year), it would be expected that 9 tickets per year would be issued to emergency services vehicles.

Staff was unable to find emergency vehicle statistics for the remaining jurisdictions with red light camera systems.

During the review of these articles, it was noted that many of the jurisdictions had internal policies for how red light camera tickets issued to municipally owned vehicles would be reviewed. If the red light camera program were adopted in the City of Greater Sudbury, similar internal policies would need to be developed as well as training materials on the potential consequences of running red lights.

Collision Statistics

It was asked at the committee meeting how the City of Greater Sudbury compares to other municipalities in terms of the number and severity of angle collisions. The Province of Ontario issues the Ontario Road Safety Annual Report. This annual report amalgamates collision data from across the province and provides collision statistics and trends. However, this report does not provide information on the types of collisions (ex. angle or rear end collisions). In order to compile the statistics, staff reviewed published statistics of Ontario municipalities. The table below summarizes the average annual number of angle collisions at all locations throughout each municipality as well as the percentage of the overall collisions that angle type collisions represent.

		Annual Average		
Municipality	Year Range	Total Collisions	Angle Collisions	Percentage
Greater Sudbury	2012-2016	2,465	320	13%
Ottawa	2014-2016	14,648	2,031	14%
Region of Waterloo	2012-2016	6,136	552	9%
Region of Peel	2010-2012	6,324	485	8%
York	2013-2015	N/A	N/A	12%

While the City of Greater Sudbury on an annual basis has less total angle collisions, the percentage of angle collisions is second highest when compared to the other four municipalities.

The committee also asked what impact the red light camera program has had on collision rates.

The statistics show that following the installation of red light cameras the reductions of right angle collisions are as follows:

City of Toronto – 60% reduction
City of Ottawa – 50% reduction
York Region – 70% reduction
Region of Waterloo – 27% reduction, 60% reduction in all turning collisions, 23% increase in rear end collisions

The City of Greater Sudbury had 40 angle type collisions between 2012 and 2016 at the three signalized intersections which have been recommended to have a red light camera system installed. Of these 40 collisions, 10 resulted in injury and the remaining 30 resulted in property only damage. Using an average 60% reduction in the right angle collisions based on the experiences of other municipalities after installing red light cameras, it would be expected that the City would have experienced 6 fewer injury collisions and 12 fewer property only damage collisions during the same 5 year period at these three intersections.

Funeral Processions

Concerns were raised by the committee about the impact the red light camera program may have on funeral processions. Following the committee meeting, staff held discussions with Gerry Lougheed Jr. of Lougheed Funeral Homes and Dave Laplante of Co-Operative Funeral Homes. Both Mr. Lougheed and Mr. Laplante are supportive of the red light camera program and the positive benefits it will provide to the community. In terms of the operational impact it may have on the funeral homes, they each stated that while it has been the community practice to allow funeral processions to travel through red lights, it is their current practice to advise families to obey all of the rules of the road while in a funeral procession and to not drive through red lights.

Staff also had discussions with the City of Hamilton. In Hamilton, funeral processions are ticketed through the red light camera program, however it is their practice to suspend the red light camera ticket if the person can provide proof that they were part of a funeral procession (ex. provide an obituary or any other evidence that they have attended the funeral). It must be noted that the practice in Hamilton is to ticket all owners of vehicles crossing on a red light, which means that all people (include those who receive tickets as part of a funeral procession) appear in Provincial Offences Court to address their matters albeit by providing evidence in order to suspend their tickets.

Exception is made for people from out-of-town, who reach out to the prosecutors ahead of the proceeding with their evidence of attending the funeral and the prosecutors address these matters in absentia by seeking suspensions.

Should the red light camera program be implemented in the City of Greater Sudbury, each of the funeral homes has volunteered to help the City verify whether or not the ticket issued is related to a funeral procession. The details of this process would be finalized with the funeral homes as the red light camera program is developed.

Red Light Camera Ticket Rate

The committee also asked what impact traffic volumes have on the frequency of red light camera tickets issued. The rate in which red light camera tickets are issued at signalized intersections is difficult to calculate. Due to environmental issues such as traffic volumes, perceived wait times, and geometric considerations, compliance at each signalized intersection can vary greatly. A 2015 report by the City of Toronto detailed the number of red light camera tickets issued at over 75 intersections. Staff reviewed the total traffic volumes over the 8 peak hours of the day at these intersections and found they ranged from 7,506 to 39,450 vehicles. However, in 2014 these same intersections issued between 8 and 1,944 red light camera tickets. Staff found that the number of tickets issued doesn't always correlate to the intersections with the higher traffic volumes. For example, in the City of Toronto, Albion Road at Silverstone Drive had 1,448 red light camera tickets issued in 2014 with a peak 8 hour traffic volume of 12,828 vehicles. Meanwhile, Sheppard Avenue at Wilson Heights Boulevard had 127 red light camera tickets issued in 2014 yet it has a peak 8 hour traffic volume of 32,661 vehicles.

The three proposed intersections in Sudbury have a peak 8 hour volume between 14,000 and 17,000 vehicles. While these traffic volumes are similar to many of the intersections in the City of Toronto, it is hard to determine whether the rate of tickets issued will fall on the high or low side of what Toronto is experiencing. The primary focus of red light camera installations is to increase intersection safety by reducing the number of vehicles which fail to stop at red lights. To this point, 'Table 4' of AECOM's report (Attachment 1) lists the 55 intersections within the City of Greater Sudbury where a red light camera installation would provide the greatest potential for safety change which is based on collision history, severity of the collisions and traffic volumes.

Miscellaneous Questions

The committee also had a serious of questions which did not fall into a specific category. These questions and responses are presented below.

Would it be possible to provide the AECOM report to the committee?

The AECOM report is provided as Attachment 1 to this report.

How will it be possible to see a police officer controlling an intersection with a red light camera? What does a red light camera ticket look like?

A sample red light camera offence notice is provided in Attachment 2.

What percentage of vehicles caught on a red light camera system have unreadable license plates?

Staff was unable to find a statistic which stated what percentage of vehicles caught on a red light camera system had an unreadable license plate.

Will a red light camera ticket impact the vehicle owner's insurance rates?

The research staff completed suggests that a red light camera ticket should not result in increased insurance rates since no demerit points are issued. However, it is recommended that individuals contact their own insurance provider to verify if a red light camera ticket will impact their rates.

References:

Toronto police vehicles caught going through red lights while not on emergency calls, CTV News Toronto, Accessed online, October 26, 2015: https://toronto.ctvnews.ca/toronto-police-vehicles-caught-going-through-red-lights-while-not-on-emergency-calls-1.2628528

Red Light Cameras – Status Update and Phase 3 Contract Award (Request for Proposal No. 9148-15-5000 - 2017 to 2021), City of Toronto, Access online, August 31, 2015: https://www.toronto.ca/legdocs/mmis/2015/pw/bgrd/backgroundfile-83498.pdf

Emergency vehicles and red light camera tickets a contentious issue, The Hamilton Spectator, Accessed online, December 17, 2015: https://www.thespec.com/news-story/6199770-emergency-vehicles-and-red-light-camera-tickets-a-contentious-issue/

Sometimes we all pay when a city vehicle runs a red light, The Hamilton Spectator, Accessed online, May 10, 2012: https://www.thespec.com/news-story/2115094-sometimes-we-all-pay-when-a-city-vehicle-runs-a-red-light/

Number of Hamilton drivers ticketed for running red lights doubles, CBC News, Accessed online, May 21, 2014: https://www.cbc.ca/news/canada/hamilton/headlines/number-of-hamilton-drivers-ticketed-for-running-red-lights-doubles-1.2649514

Emergency services see red over traffic tickets, Ottawa Citizen, Accessed online, May 25, 2009: https://www.pressreader.com/canada/ottawa-citizen/20090525/281530811983770

4,900 caught red-handed but no ticket, Ottawa Sun, Accessed online, June 14, 2016: http://ottawasun.com/2016/06/14/4900-caught-red-handed-but-no-ticket/wcm/6fb42e5a-c2e1-4185-befa-01f40e98227b

City of Ottawa 2016 Tabular Transportation Collision Data, Accessed online: http://data.ottawa.ca/dataset/collisiondata2016

City of Ottawa 2015 Tabular Transportation Collision Data, Accessed online: http://data.ottawa.ca/dataset/collisiondata2015

City of Ottawa 2014 Tabular Transportation Collision Data, Accessed online: http://data.ottawa.ca/dataset/collisiondata2014

Region of Waterloo Annual Collision Report 2016, Accessed online: https://www.regionofwaterloo.ca/en/living-here/resources/Roads-and-Traffic/Collision-Reporting/Annual-Collision-Report-2016.pdf

Region of Peel Traffic and Road Safety Performance Report 2014, Accessed online: https://www.peelregion.ca/council/agendas/2015/2015-01-22-rc-agenda.pdf

Region of York 2016 Annual Traffic Safety Report, Accessed online: https://www.york.ca/wps/wcm/connect/yorkpublic/18f6fe47-02ea-4e3b-9fde-445e2bb9e6b4/2016TrafficSafetyReport.pdf?MOD=AJPERES&CACHEID=18f6fe47-02ea-4e3b-9fde-445e2bb9e6b4

Red Light Cameras Statistics, City of Toronto, Website, Accessed Online: https://www.toronto.ca/services-payments/streets-parking-transportation/traffic-management/pavement-markings/red-light-cameras/

City of Ottawa, "City increases the number of intersections with red light cameras", May 22, 2018, Accessed Online: https://ottawa.ca/en/news/city-increases-number-intersections-red-light-cameras

Red Light Cameras , York Region, Accessed Online: http://www.york.ca/wps/portal/yorkhome/transportation/yr/traffic/redlightcameras/!ut/p/a1/jZDBbsIwDIafaLXJgOaadbC0DFptB0IuKHRJGqItUIhWiadfmHbdmG-Wvt_-bJAgQI7q01kVnR9Vf-vl8liyl5LzDVb1nBbIsGYVySmumkUCDgnAX4rhvXz1jwUkbIutBXIWsXtwo_EgYIDGuBZE0B-9s11s1aCDusAe5PdEQuZLPiuwQI5TLNd5s3imfIYkvwNsyA_wx01J2vb-

lP6zf0pa5n29szdRNp4eaRIN2uigQ9b5SwQxTVNmvbe9zlo_wHkQ11eOrhneDl94Mqvl/dl5/d5/L2dBISEvZ0FBIS9nQSEh/#.WzEtiVsrK71

Red Light Cameras, Region of Waterloo, Accessed Online: https://www.regionofwaterloo.ca/en/living-here/red-light-cameras.aspx

Attachment 1

City of Greater Sudbury

Needs and Justification for Red Light Camera Program

Contract ISD15-10

Prepared by:

AECOM Canada Ltd.
105 – 1361 Paris Street
Sudbury, ON P3E 3B6
Canada

T: 705 674 8343
F: 705 674 1694
www.aecom.com

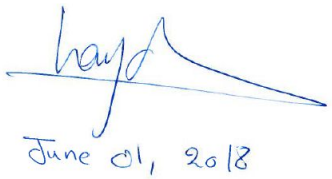
Prepared for:

City of Greater Sudbury
200 Brady Street
P.O. Box 5000, Stn. A
Sudbury, ON P3A 5P3

Date: June 01, 2018

Project #: 60558166

Quality information

Prepared by	Checked by	Approved by
		
Haider Talib, EIT Transportation Engineering Intern	Hossein Zarei, P.Eng. Technical Lead	Keir Thomas, P.Eng. Project Manager

Revision History

Revision	Revision date	Details	Name	Position
00	04/30/2018	Draft for Client Review	Keir Thomas, P.Eng.	Project Manager
01	05/24/2018	Client Comments Addressed	Haider Talib, EIT.	Transportation Engineering Intern
02	06/01/2018	Client Comments Addressed	Haider Talib, EIT.	Transportation Engineering Intern

Distribution List

# Hard Copies	PDF Required	Association / Company Name
	Y	AECOM Canada
	Y	City of Greater Sudbury

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("AECOM") for the benefit of the Client ("Client") in accordance with the agreement between AECOM and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- represents AECOM's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.

AECOM shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. AECOM accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

AECOM agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but AECOM makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

Without in any way limiting the generality of the foregoing, any estimates or opinions regarding probable construction costs or construction schedule provided by AECOM represent AECOM's professional judgement in light of its experience and the knowledge and information available to it at the time of preparation. Since AECOM has no control over market or economic conditions, prices for construction labour, equipment or materials or bidding procedures, AECOM, its directors, officers and employees are not able to, nor do they, make any representations, warranties or guarantees whatsoever, whether express or implied, with respect to such estimates or opinions, or their variance from actual construction costs or schedules, and accept no responsibility for any loss or damage arising therefrom or in any way related thereto. Persons relying on such estimates or opinions do so at their own risk.

Except (1) as agreed to in writing by AECOM and Client; (2) as required by-law; or (3) to the extent used by governmental reviewing agencies for the purpose of obtaining permits or approvals, the Report and the Information may be used and relied upon only by Client.

AECOM accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of AECOM to use and rely upon the Report and the Information. Any injury, loss or damages arising from improper use of the Report shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

AECOM: 2015-04-13

Table of Contents

Appendices

Figures

Tables

1. Introduction

1.1 Background

Traffic signals and other traffic control devices are generally installed in order to reduce the number of "conflicts" at intersections. Reducing conflicts, between two or more vehicles and between vehicles and pedestrians, can improve safety and operation of the intersection by separating and controlling the movements of competing traffic and pedestrian movements. However, some motorists intentionally choose to disobey traffic signals and, in doing so, increase the risk of collisions at intersections. Of particular concern at signalized intersections is red-light violation, or "running the red-light", which increases the potential for right-angle collisions. Right-angle collisions in particular can result in more severe damage to vehicles involved, and are more likely to result in injuries to vehicle occupants in comparison to other types of collision impacts, such as rear-end collisions.

There is currently no consistent approach to resolve red-light running issues. There have been safety programs created that include a wider range of engineering, educational, and enforcement measures that are either used individually or in combination in an attempt to reduce or stop red-light running occurrences. From a general engineering perspective, coordinated signal timing plans and improved visibility of traffic signal displays are the two common red-light running treatments in North America. Over the past three decades, many jurisdictions in North America, including several municipalities in Ontario, have also deployed Red-Light Cameras (RLCs) to automate enforcement as a means of reducing the number of red-light running incidents.

An RLC program was initiated in Ontario as a pilot project in November 2000. The six Ontario municipalities who first started using RLCs were City of Toronto, City of Ottawa, City of Hamilton, as well as the Regional Municipalities of Waterloo, Halton, and Peel. A study undertaken in 2003 by one of the AECOM's legacy companies (i.e., Synectics Transportation Consultants) showed the benefits of the RLC program[1] and subsequently, the program received permanent provincial endorsement in 2004. The Regional Municipality of York and City of London have since also joined the RLC program.

At RLC-equipped intersections, an RLC is installed upstream of the intersection, most often on one approach, facing towards the intersection. The RLC takes photographs of the rear of the red-light running vehicles before and after a vehicle crosses the stop bar while the red signal indication is displayed, from which the license plate can then be read and a ticket issued.

Previous studies have shown that on average RLCs reduce right-angle collisions at signalized intersections but they have also been reported to result in an increase of rear-end collisions, at least in the short term. Although frequency of rear-end collisions are typically higher than right-angle collisions at signalized intersections, right-angle collisions tend to be more severe; i.e., more likely to result in injuries to vehicle occupants in comparison to rear-end collisions. Hence, assessment of needs and justification as well as selection of appropriate intersections for RLC installations are two primary, yet key decisions to success of the RLC program; i.e., that the installation of RLCs would lead to an overall reduction in the severity of collisions.

[1] Synectics Transportation Consultants, Evaluation of Red Light Camera Enforcement Pilot Project, Final Technical Report, December 2003.

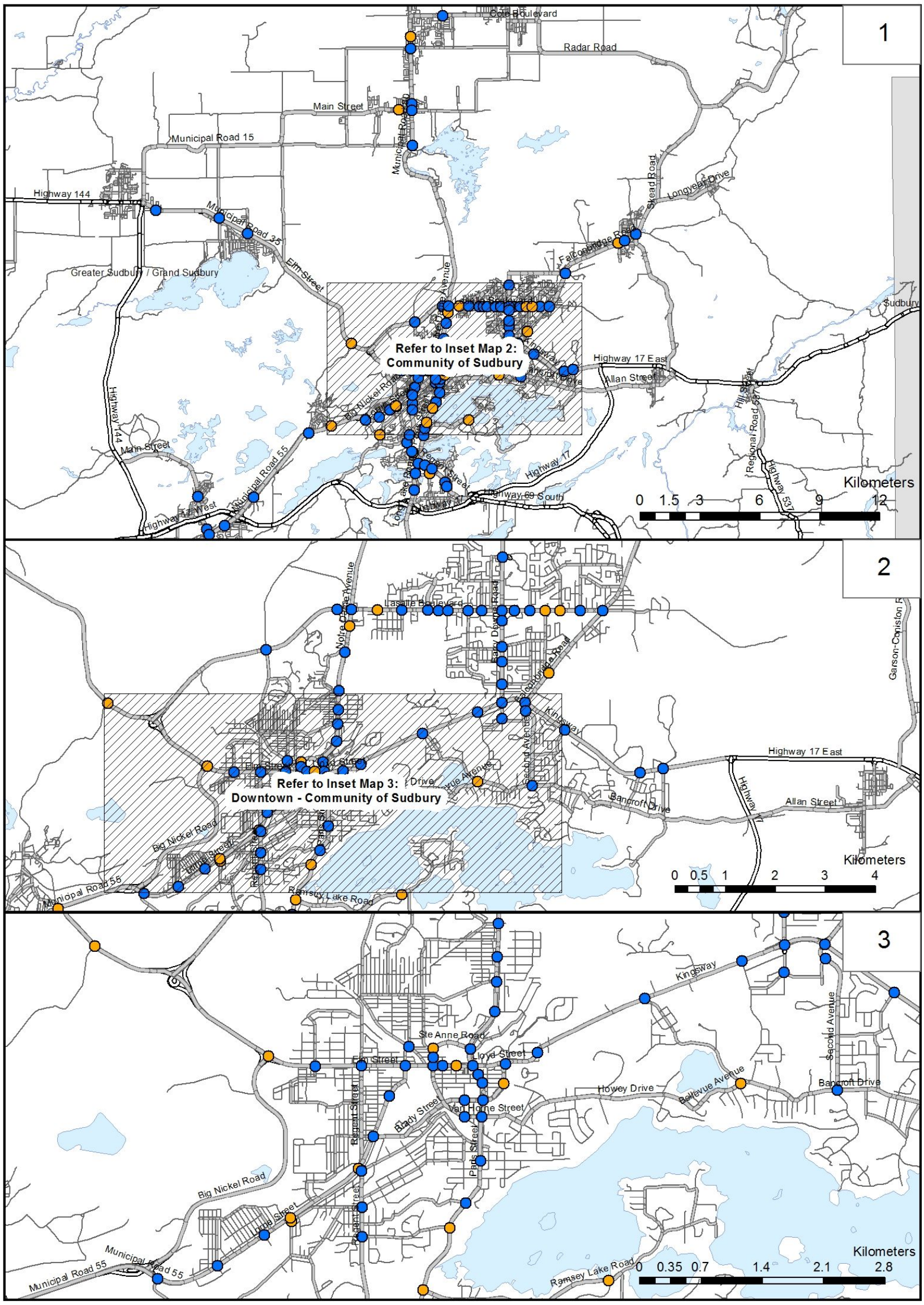
1.2 Study Objectives

In line with the City of Greater Sudbury's goal to provide safe, efficient, and environmentally-sustainable transportation services, the City has initiated a study and retained AECOM to determine the needs and justification to start a City-wide RLC program and to identify the intersections which would benefit the most from installation of RLCs.

1.3 Study Area

City of Greater Sudbury is the largest city in Ontario by land area, and the largest city in Northern Ontario by population of about 161,000 residents as per the Canada 2016 Census.[2] The population reside in an urban core and many smaller communities that are scattered around the urban core such as Valley East, Nickel Centre, etc. Figure 1 shows the geographical distribution of all signalized intersections in the city of Greater Sudbury.

[2] www.greatersudbury.ca



City of Greater Sudbury: Red Light Camera Assessment: **Existing Conditions**

Legend

- Freeway
- Arterial
- Collector
- Local
- 3 Leg Intersection
- 4 Leg Intersection
- Water Body

N

Data Source: City of Greater Sudbury, Province of Ontario Open Data (c) 2018

Path: \\URSToronto\Toronto\Markham\PRJ\SHome\Users\zareih\Projects\City of Greater Sudbury - Red Light Camera\5. Mapping\MXD\3. City of Greater Sudbury - Existing - Zoomed.mxd
Time: 1:01:33 PM Date: 5/14/2018

Figure 1: Signalized Intersections in the Greater Sudbury Area

2. Literature Review on Safety Benefits of RLCs

Since the 1970s, numerous jurisdictions in Europe, Australia, and North America have been using RLCs with the aim of reducing red-light violations and the resulting collisions. A number of studies have been conducted by researchers to evaluate safety benefits of RLCs *(1 – 9)*. The majority of the past studies' findings appear to support a conclusion that RLCs reduce right-angle collisions and could increase rear-end collisions whereas there is no evidence that RLC installation affects other collision impact types[3]. Hence, to assess the needs and justification for installation of RLCs in the City of Greater Sudbury and to identify intersections that would benefit the most from the RLC installations, the effect of RLCs on right-angle and rear-end collision frequencies were estimated.

Accurately quantifying the safety effects of an RLC program has generally been a challenging task. This has been evidenced by relatively considerable variations in study findings on magnitude of the safety benefits of the RLC programs. However, for the purpose of the City of Greater Sudbury's Study and based on findings of the most reliable multi-jurisdictional safety evaluation of RLCs[4], it is assumed that RLCs reduce right-angle collisions at signalized intersections by 25% and initially increase rear-end collisions by 15%.

In addition, the previous studies have shown that the safety benefits of RLCs usually spill-over from the RLC-equipped intersections (i.e., "treated" intersections) to the adjacent signalized intersections that do not have RLCs (i.e., "untreated" intersections). In other words, RLCs not only result in a fewer number of red-light running / violations at the treated intersections but they also modify driving behaviour at the untreated intersections because of the jurisdiction-wide publicity of an RLC program and the general public's lack of knowledge of where RLCs are installed. However, the literature review showed that the spill-over effect is typically a longer-term result of the RLC program and its order of magnitude has not been thoroughly examined / precisely quantified in the literature. Therefore, the spill-over effects was not directly accounted for in assessing the needs and justification for installation of RLCs in the City of Greater Sudbury.

Furthermore, the available literature shows that failure to account for the "regression-to-the-mean" (RTM) phenomenon could result in overestimation of RLCs safety benefits. RTM occurs where intersections are selected for RLC installations based on their high number or rate of right-angle collisions and low number of rear-end collisions which would have reduced and increased, respectively, whether or not an intervention was made.[5] Hence, for the purpose of the City of Greater Sudbury's Study and as further explained in Section 4, the Empirical Bayes (EB)[6] approach was adopted to control for the RTM phenomenon and to estimate the expected number of right-angle and rear-end collisions.

[3] American Association of State Highway and Transportation Officials (AASHTO), Highway Safety Manual, 2010
[4] Persaud, B., Council, F. M., Lyon, C., Eccles, K., and Griffith, M., "A Multi-Jurisdictional Safety Evaluation of Red Light Cameras.", Transportation Research Record 1922, (2005) pp. 29-37
[5] Solomon H., Izadpanah, P., Brady, M, and A. Hadayeghi, *So You're Considering a Red Light Camera Program? Lessons and Insights from over a Decade of Camera Operation in South and Central Ontario*, paper prepared for presentation at the Road Safety Policy Development – Past, Present, Future session of the 2014 Conference of the Transportation Association of Canada, Montreal, Quebec, Source: http://conf.tac-atc.ca/english/annualconference/tac2014/s-6/solomon.pdf
[6] The Empirical Bayes (EB) methodology adopted in this report is an industry standard, it is referred in the 2010 Highway Safety Manual.

3. Data Collection, Verification, and Processing

3.1 Data Collection

The City of Greater Sudbury provided the AECOM project team with the historical data on the motor vehicle collisions that were reported to occur at the City's signalized intersections over a period of 5 years from January 1, 2012 to December 31, 2016. The City also provided the available annual average daily traffic (AADT) volumes for both major and minor intersecting roadways at the signalized intersections over the same period of time. Each of these two datasets is discussed in the following sub-sections with more details.

The additional data provided by the City include traffic signal installation year, description of modifications (if any) made to intersection geometry and traffic control devices at the signalized intersections within the study period, among others.

3.1.1 Traffic Volume Data

For each intersection, the traffic volume database contains a unique intersection ID (i.e., a six-digit number called GEOID), description of intersecting roadways, number of legs, AADT volumes on all approaches, entering AADT volumes from both major and minor intersecting roadways, and year in which AADT volumes were collected. Note that for each intersection, the City provided AADT volumes only for one year out of five years between 2012 and 2016; i.e., there is only one set of AADT volumes per intersection. The database also contains information about the implementation year and type of geometric improvements (if any) made to the City's signalized intersections over the five-year study period.

3.1.2 Collision Data

The City also provided the motor vehicle collision data for the five-year study period. The database included all of the collisions that were coded as either "at intersection" or "intersection-related". The collision data were made available as an Excel file. For each collision record, the collision database contains a unique collision ID, date and time of occurrence (including year, month, day, and time), GEOID and description of the intersection at which or in its vicinity the collision has occurred, classification or severity (i.e., fatal injury, non-fatal injury, property damage only, non-reportable, and other / unknown), initial impact type (e.g., angle, rear-end, sideswipe, turning movement, single motor vehicle, etc.), environment condition (i.e., weather condition), light condition (e.g., daylight, dark, dawn, etc.), driver condition (e.g., driving properly, following too close, disobeyed traffic control, etc.), road surface condition (e.g., dry, wet, slush, etc.), driver action(s), initial direction(s) of travel, direction of travel in which at-fault driver was travelling (if known), and the traffic signal condition (e.g., functioning, obscured, etc.).

3.1.3 Other Data

As discussed further in Section 4.3, the City also provided the AECOM project team with the signal timing plans and design drawings of the City's candidate intersections that were identified for the RLC installations.

3.2 Consistency and Completeness Checks and Modifications of Data

In general, accuracy of analysis findings is highly dependent on extent and quality of data inputs. Based on a preliminary assessment, the available data (i.e., total number of intersections and collisions as well as number of their available data fields) was found sufficient to complete a statistically valid collision assessment to achieve the study objectives. However, as a matter of due diligence and to confirm and enhance (where needed) quality of the traffic volume and collision data, the City's and AECOM project teams conducted a set of consistency checks and subsequent modifications.

With respect to the collision data and in consultation with the City staff, all of the self-reported collisions were excluded from the database. This was done due to low level of confidence in validity of the "self-reported" collision records. It is worth mentioning that only rear end and right angle collisions data are used in the study since RLCs impact is limited to these two types of collisions. The study team also identified some missing data with respect to the collision classification, initial impact type, and vehicle direction of travel fields. There were also some inconsistencies between the reported initial impact type and the direction of travel of vehicles. For example, for some of the records reported as angle collisions, the reported directions of travel for the two vehicles involved were not perpendicular. Similarly, there were records of rear-end collisions for which it was reported that vehicles were traveling in opposite directions of travel. Subsequently, and with verifications of the identified data fields against the related motor vehicle collision reports (MVCRs) by the City staff, the identified data inconsistencies were corrected and the identified missing information were populated. A portion of the missing information on collision classification and / or initial impact type that cannot be confidently determined was categorized as "other".

With respect to the traffic volume data, the study team focused on identifying the intersections for which the AADT volume field was blank and those with more than one GEOID (i.e., duplicate GEOIDs) data as shown in Table 1. Subsequently, the City staff provided the AADT volumes and verified the correct GEOIDs. In addition, the following two intersections were also excluded from the database because their traffic signals were installed in 2017 because the collision data provided corresponded to the period before installation of the signals:

- Second Avenue and Scarlett Road; and
- Second Avenue and Kenwood Street.

Following the above-noted data modifications, the collision database was linked to the traffic volume database using the GEOID field to form a master database. Finally, the master database was divided into two datasets; one for the three-legged intersections and one for the four-legged intersections.

Table 1: List of the Intersections with Missing AADT or Duplicate GEOIDs

Intersection	Type of Issue
Brady Street and Lloyd Street	Duplicate GEOID
Municipal Road 55 and Magill Street	Duplicate GEOID
Lorne Street and Rowat Street	Duplicate GEOID
Regent Street and Walford Road	Duplicate GEOID
Falconbridge Road and Penman Avenue	Missing AADT Volumes
Caswell Drive and Regent Street	Missing AADT Volumes

3.3 Overview of the City's Collision Data

As stated in Section 2 of the Report, based on the most reliable past research studies, RLCs on average reduce right-angle collisions by 25% and increase rear-end collisions by 15% and there is no evidence that RLC installation affects other collision impact types. Hence, for the purpose of this study, right-angle and rear-end collisions were considered as target collisions.

Excluding the two noted intersections on Second Avenue that were signalized in 2017, there are 94 four-legged and 20 three-legged signalized intersections within the City boundaries. There were 464 right-angle and 1622 rear-end collisions reported to occur at these signalized intersections over the five-year study period. Figure 2 shows frequencies and proportion of injury and property-damage-only (PDO) collisions for the right-angle collisions. Figure 3 shows the same information for the rear-end collisions. Intuitively and consistent with the past studies, right-angle collisions are shown to result in more severe collisions than rear-end collisions. It is essential to note that there is no record of fatal right-angle and rear-end collisions at the City's signalized intersections over the five-year study period.

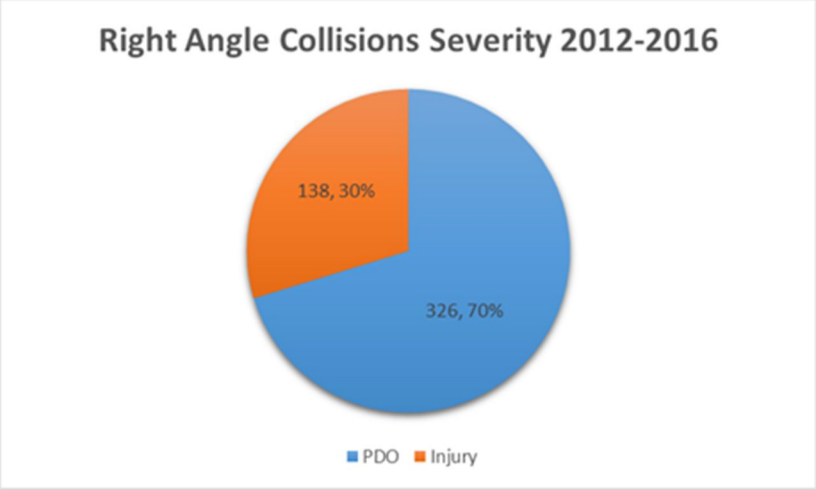


Figure 2: Frequency and Proportion of Right-Angle Collisions by Severity

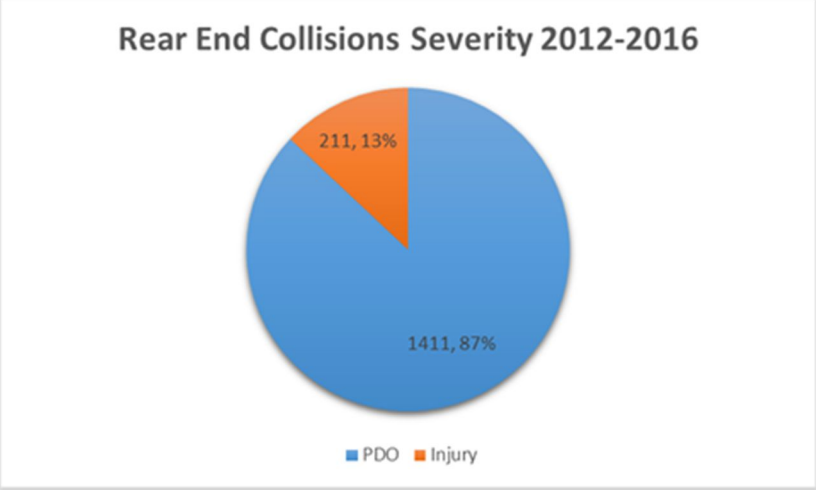


Figure 3: Frequency and Proportion of Rear-End Collisions by Severity

4. Study Methodology and Findings

This Section is intended to present the methodology adopted to achieve the study objectives stated in Section 1.2. The study was broken down into the following four tasks:

- Develop safety performance functions (SPFs) separately for the three-legged and four-legged signalized intersections;
- Identify candidate signalized intersections for installation of RLCs;
- Undertake field investigations and engineering assessment of the candidate signalized intersections; and
- Identify signalized intersections that would benefit the most from installation of RLCs.

4.1 Develop Safety Performance Functions for the Signalized Intersections

As stated in Section 2 and for the purpose of this study, the EB method was adopted as a superior method to estimate the expected frequencies of target collisions (i.e., right-angle and rear-end collisions) at all of the City's signalized intersections in the status quo (i.e., without RLCs). The EB method aims to smooth out typical random fluctuations in any specific intersection's collision history and estimate the expected collision frequency $E\{m\}$ for both right-angle and rear-end collisions at the intersection. For either of the two target collisions, the expected collision frequency is calculated as a weighted average of the historical (observed) collision frequency (x) and predicted collision frequency $E(Y)$ which is in turn obtained based on historical collision frequencies of numerous other intersections with similar characteristics in terms of entering AADT volumes, number of legs, traffic control devices, etc. The following formula mathematically expresses the EB method.

$$E\{m\} = w * E(Y) + (1 - w) * x$$

To predict the collision frequencies $E(Y)$ of the target collisions and to calculate the noted weight (w) in the above-noted formula, safety performance functions (SPFs), also known as collision prediction models, are needed. Hence, as part of this study and using the most recent five-year historical collision data and the related entering AADT volumes at three-legged and four-legged signalized intersections, SPFs were developed to predict the number of right-angle and rear-end collisions at those signalized intersections. As illustrated in Figure 4, separate SPFs were developed for four-legged and three-legged intersections.

For each of the two intersection categories, SPFs were developed separately for right-angle and rear-end collisions.

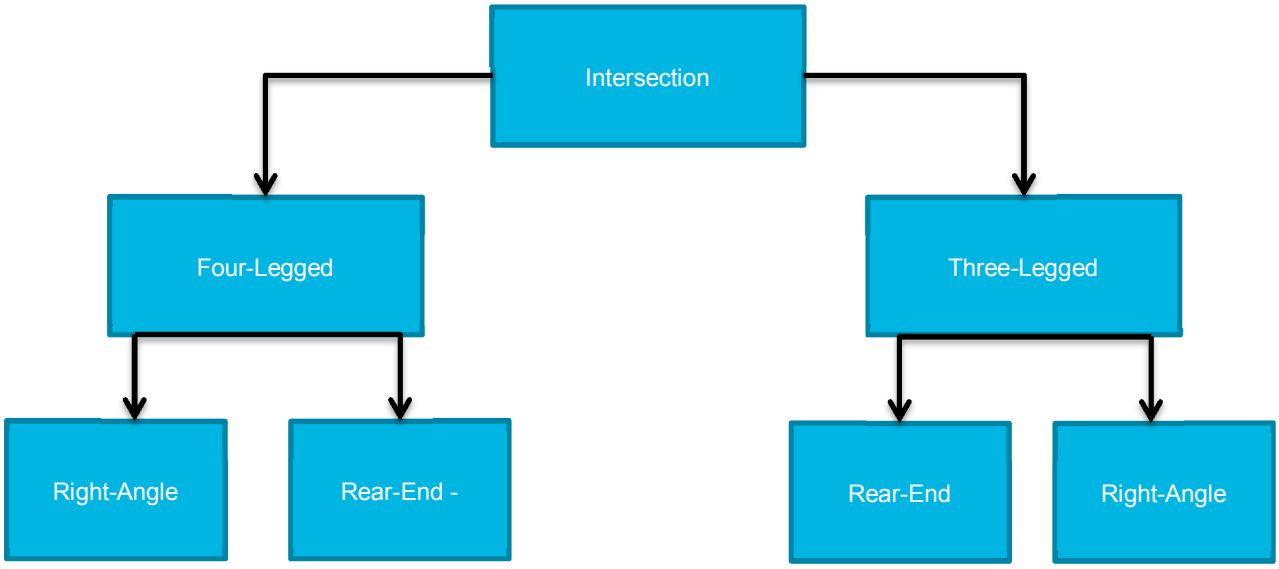


Figure 4: Intersection-Collision Impact Type Categories for SPF Development

Table 2 and Table 3 present SPFs to predict number of right-angle and rear-end collisions for both signalized four-legged and three-legged intersections respectively.

Table 2: SPFs for Signalized Four-Legged Intersections

Collision Impact Type	Equation	Intercept (α)	β_1	k
Angle	$E(Y) = \alpha * (MajorAADT + MinorAADT)^{\beta_1}$	-12.72	1.29	0.74
Rear-End		-21.33	2.23	0.61

Table 3: SPFs for Signalized Three-Legged Intersections

Collision Impact Type	Equation	Intercept (α)	β_1	β_2	k	C_1	C_2
Angle	$E(Y) = \alpha * (MajorAADT)^{\beta_1} * (Minor\ AADT)^{\beta_2}$	-12.13	1.11	0.26	0.33	0.10	1.40
Rear-End		-12.13	1.11	0.26	0.33	0.53	1.91

Where, α, β_1, β_2 are the model parameters.

C_1, C_2 are the calibration factors that were calculated based on the AASHTO Highway Safety Manual (HSM) guidelines and subsequently, used in development of SPFs for the City's three-legged signalized intersections.

k is the over-dispersion parameter used in calculating the weight (w).

4.2 Identify Candidate Intersections for RLCs

4.2.1 Potential for Safety Change as a Result of RLC Installations

In order to determine if, at what locations, and to what extent the RLC installations would result in net potential safety benefits to the City of Greater Sudbury, the AECOM project team estimated potential for safety change (PSC) at all signalized intersections. The PSC is defined as the difference between the expected number of the target collisions (i.e., right-angle and rear-end collisions) before and after RLC installations at that intersection and it is described in terms of equivalent PDO (EPDO) collisions. The EPDO is used as unit of measurement because it allows for assigning a greater weight to right-angle collisions due to their more severe nature (thus, greater societal costs) than rear-end collisions in calculation of the PSC for each intersection.

The first step in estimating the PSC for an intersection is to evaluate the expected number of target collisions with no RLC in place. As described in Sub-section 4.1, the expected number of target collisions at the intersection in the absence of RLCs is estimated using the EB method.

The second step is to project the expected number of target collisions at the intersection if an RLC is installed. The expected number of target collisions with an RLC is estimated by multiplying the applicable collision modification factors (CMFs) to the expected number of collisions before the RLC installation. As stated in Section 2, the CMFs for the target collisions are:

- 0.75 for right-angle collisions; this represents 25% reduction in right-angle collisions following RLC installation, and
- 1.15 for rear-end collisions; this represents a 15% increase in rear-end collisions.

Finally, the PSC for an intersection is calculated by subtracting the expected number of collisions if an RLC was in place and the expected number of collisions with no RLC in place at the intersection. A negative PSC represents a potential for safety improvement and a positive PSC represents a potential for safety deterioration.

Table 4 presents the PSC values for each signalized intersections, ranked in descending order of predicted benefit. For example, the intersection of Paris Street and Cedar Street, if equipped with an RLC, is expected to experience a reduction of approximately four fewer EPDO collisions per year. As shown in Table 4, a total of fifty five signalized intersections were identified as those with negative PSC values. In other words, it was determined that fifty five intersections would gain safety benefits from installation of RLCs. This finding satisfies the first objective of this study that there is a justification for installation of RLCs from a road safety standpoint. It is essential to note that out of the original 114 signalized intersections, 20 of the intersections had no record of right-angle collisions within the five-year study period and therefore, were excluded from further analysis. This reduces the total number of signalized intersections that were carried forward for further analysis to 94.

Table 4: Intersection Ranking Based on the PSC Index

Rank	GEO ID	Intersection	PSC index	Intersection type
1	145100	Paris @ Cedar	-4.3420	4-Legged
2	145121	Paris @ Van Horne	-2.0237	4-Legged
3	144278	Lorne @ Douglas	-1.9754	4-Legged
4	144144	Regent @ Beatty	-1.8621	4-Legged
5	145358	Notre Dame @ Cambrian Heights	-1.6133	4-Legged
6	144866	Regent @ Algonquin	-1.5837	4-Legged
7	144062	Municipal road 80 @ Dominion	-1.5570	4-Legged
8	145783	Lasalle @ Montrose	-1.0664	4-Legged
9	145054	Notre Dame @ Elm	-1.0616	4-Legged
10	145259	Notre Dame @ Kathleen	-1.0285	4-Legged
11	144606	Paris @ Walford	-0.9564	4-Legged
12	144738	Elm @ Elgin	-0.9512	4-Legged
13	145220	Municipal road 80 @ Elmview	-0.9046	4-Legged
14	146232	Barry Downe @ Hawthorne	-0.8453	4-Legged
15	144424	Lorne @ Walnut	-0.8104	4-Legged
16	146404	Bancroft @ Second	-0.8086	4-Legged
17	145140	Paris @ Larch	-0.7906	4-Legged
18	143506	Lorne @ Gutcher	-0.7243	4-Legged
19	144286	Long Lake @ St Charles Lake	-0.7242	4-Legged
20	145242	Lasalle @ Crescent Park	-0.6831	4-Legged
21	144171	Regent @ York	-0.6501	4-Legged
22	143280	Lorne @ Kelly Lake	-0.6477	4-Legged
23	146734	Lasalle @ Gary	-0.6414	4-Legged
24	142896	Municipal road 55 @ Magill	-0.5113	4-Legged
25	146233	Barry Downe @ Marcus	-0.4792	4-Legged
26	143636	Main Street @ Marie Avenue	-0.4685	4-Legged
27	147382	Falconbridge @ Church	-0.4627	4-Legged
28	144155	Regent @ Riverside	-0.4602	4-Legged
29	146077	Lasalle @ Roy	-0.3996	4-Legged
30	145040	Notre Dame @ St Anne	-0.3801	4-Legged
31	144641	Paris @ Centennial	-0.3694	4-Legged
32	146228	Barry Downe @ Gemmell	-0.3612	4-Legged
33	145833	Lasalle Blvd. @ Lasalle Court Mall	-0.3602	4-Legged
34	146287	Lasalle Blvd. @ Superstore	-0.3131	4-Legged
35	144121	Regent @ Telstar	-0.3037	4-Legged
36	147073	Falconbridge @ Maley	-0.3018	4-Legged

Rank	GEO ID	Intersection	PSC index	Intersection type
37	146222	Barry Downe @ NSSM	-0.2848	4-Legged
38	147113	Kingsway @ Moonlight	-0.2645	4-Legged
39	142724	Municipal road 55 @ Hillcrest	-0.2593	4-Legged
40	144258	Long Lake @ Countryside	-0.2451	4-Legged
41	143695	Elm Street @ Ethelbert Street	-0.2227	4-Legged
42	143887	Regent @ Bouchard	-0.2150	4-Legged
43	143384	Kelly Lake @ Copper	-0.1970	4-Legged
44	144575	Frood @ College	-0.1966	4-Legged
45	146243	Barry Downe @ Lillian	-0.1957	4-Legged
46	145493	Kingsway @ Cochrane	-0.1775	4-Legged
47	143999	Regent @ Martindale	-0.1636	4-Legged
48	144807	Elm @ Durham	-0.1432	4-Legged
49	142394	Municipal Road 35 @ Elizabeth	-0.1424	4-Legged
50	145143	Paris @ Brady	-0.1355	4-Legged
51	144734	Elgin @ Beech	-0.1156	4-Legged
52	146618	Lasalle @ Lansing	-0.0989	4-Legged
53	144141	Municipal Road 80 @ Valleyview	-0.0362	4-Legged
54	142874	MR 35 @ Marier Street	-0.0343	4-Legged
55	147296	Falconbridge @ Margaret	-0.0072	4-Legged
56	146229	Barry Downe @ Westmount	0.0248	4-Legged
57	146378	Lasalle @ Paquette	0.0356	4-Legged
58	146649	Kingsway @ Third	0.0486	4-Legged
59	144557	Elm @ Lorne	0.0563	4-Legged
60	144639	Regent @ Old Burwash	0.0674	4-Legged
61	145884	Lasalle @ Arthur	0.0947	4-Legged
62	145327	Brady @ Lloyd	0.0957	4-Legged
63	145267	Notre Dame @ King	0.1515	4-Legged
64	147070	Kingsway @ Levesque	0.1602	3-Legged
65	147254	Falconbridge Road @ Penman Avenue	0.1937	3-Legged
66	144193	Regent @ Caswell	0.2081	3-Legged
67	146055	Bancroft @ Bellevue	0.2156	3-Legged
68	144922	Elm @ Lisgar	0.2181	3-Legged
69	142633	Municipal Road 55 @ Black Lake	0.2250	4-Legged
70	144873	Paris @ York	0.2330	3-Legged
71	143574	Lorne @ Martindale	0.2523	4-Legged
72	144107	Lorne @ Regent	0.3095	3-Legged
73	144052	MR 80 @ Jeanne D'Arc Street	0.3193	3-Legged
74	145278	Notre Dame @ Wilma	0.3198	4-Legged

Rank	GEO ID	Intersection	PSC index	Intersection type
75	144269	Lasalle @ Frood	0.3306	4-Legged
76	143517	Elm @ Big Nickel	0.3577	3-Legged
77	145675	Ramsey Lake @ LU	0.4294	3-Legged
78	143240	Elm @ Clarabel	0.4563	3-Legged
79	143181	Municipal Road 55 @ Balsam	0.4624	3-Legged
80	146555	Falconbridge @ Auger	0.5039	4-Legged
81	146525	Lasalle @ Auger	0.6528	3-Legged
82	145598	Lasalle @ somers	0.7086	3-Legged
83	144123	MR 80 @ Main Street	0.8095	4-Legged
84	146916	Lasalle @ Falconbridge	0.8373	4-Legged
85	145995	Lasalle @ Attlee	0.8646	4-Legged
86	145239	Notre Dame @ Leslie	1.0085	4-Legged
87	145674	Lasalle @ Rideau	1.0804	4-Legged
88	144415	Regent @ Long Lake	1.1688	4-Legged
89	145759	Kingsway @ Bancroft[7]	1.1833	4-Legged
90	146221	Lasalle @ Barry Downe	1.2735	4-Legged
91	146239	Kingsway @ Barry Downe	1.2983	4-Legged
92	145417	Lasalle @ Notre Dame	1.6878	4-Legged
93	144673	Paris @ Ramsey Lake	2.1314	3-Legged
94	146342	Kingsway @ Falconbridge	2.5646	4-Legged

4.2.2 Additional Candidate Intersections

Available data were limited in that AADT data were only available for one year at each intersection, as compared with five years of collision data at each intersection. This raised the possibility that intersections existed which could benefit from RLC installation but were excluded from the original top six lists because of the data limitations. Accordingly, AECOM undertook a review of the collision data to identify intersections with high frequency of right-angle collisions that may have been excluded from the top six list, and determine whether there is reason to believe that they might also benefit from RLC installation.

Table 5 shows the eight signalized intersections with the highest number of right-angle collisions over the study period and ranked in a decreasing order. It also shows the estimated PSC values for these intersections and their ranks from Table 4.

[7] Traffic volumes and collision data were received after the submission of the draft report and therefore, were not included in the development of the SPF models for the city's intersections

Table 5: Top Eight Intersections based on Total Number of Right-Angle Collisions between 2012 and 2016

GEOID	Rank	Rank in Table 4	Intersection Description	PSC Value	Total Number of Right-Angle Collisions (2012 - 2016)
145100	1	1	Paris Street and Cedar Street	-4.34	21
144144	2	4	Regent Street and Beatty Street	-1.86	20
144738	3	12	Elm Street and Elgin Street	-0.95	16
146221	4	90	LaSalle Boulevard and Barry Downe Road	1.27	16
145121	5	2	Paris Street and Van Horne Street	-2.02	15
145143	6	50	Paris Street and Brady Street	-0.14	13
144415	7	88	Regent Street and Long Lake Road	1.17	13
144062	8	7	Municipal Road 80 and Dominion Road	-1.56	10

Intersections in tables 4 and 5 were combined. After deleting duplicate entries and locations with positive PSC values, a total of nine candidate sites remained.

Of the remaining nine locations, it was noted that three were in close proximity to one another, namely Paris @ Cedar, Paris @ Brady, and Paris @ Van Horne. Since it is expected that the RLC spill-over effect will benefit intersections near those where an RLC is installed, it was agreed to eliminate two of the three sites from the short-list. Paris @ Cedar was carried forward because it had the greatest potential safety change of all sites in the City.

After the list was modified as per above, a total of seven sites remained. Since all seven sites showed a potential safety improvement from RLC installation and there was no significant reason to select any site over the others, the City issued a change order to increase the number of sites carried forward to office and field investigations from six to seven. The final seven locations are:

- Paris Street and Cedar Street
- Lorne Street and Douglas Street
- Regent Street and Beatty Street
- Notre Dame Avenue and Cambrian Heights Drive
- Regent Street and Algonquin Road
- Elm Street and Elgin Street
- Municipal Road 80 and Dominion Road

4.3 Field Investigations and Engineering Assessment

The objective of RLC installations is to reduce collisions by reducing the number of intentional red-light running incidents. It should be noted, however, that conditions may be present which contribute to unintentional red light running and could, if addressed, provide the intended safety improvement more quickly, efficiently or cost-effectively than installing RLCs. Accordingly, the AECOM project team conducted a set of engineering assessments and field investigations to identify potential factors contributing to unintentional red light running incidents, and other factors which may impact the safety of each of the top seven intersections.

4.3.1 Engineering Assessment

Prior to the field investigation stage, the AECOM project team reviewed the signal timing plans of the seven candidate intersections to confirm adequacy of amber and all-red clearance intervals. Timing plans were compared with the timing guidelines outlined in the Ontario Traffic Manual (OTM) Book 12[8].

The duration of an amber interval is set to provide adequate advance time to an approaching motorist about the forthcoming change from amber to red. In addition, the all-red clearance interval is intended to allow a motorist who has entered the intersection (driven past the stop line) to have enough time to clear the intersection before the start of green interval for the next traffic signal phase. Based on the office review, the duration of clearance intervals were found to be acceptable, with the exception that at some intersections, the current all-red clearance intervals are slightly shorter than the minimum recommended values in the OTM Book 12. However, the slightly shorter all-red clearance intervals are not expected to be a contributing factor behind the observed right-angle and rear-end collisions at the seven candidate intersections; thus, all of the seven candidate intersections were carried forward for the field investigations.

In preparation for the field investigations and based on the available collision data, the AECOM Project team developed a scoring methodology to rank the legs of each intersection in terms of the reported number of collisions for which the at-fault driver was driving on. The at-fault drivers and the intersection leg on which the at-fault driver was travelling were identified based on the available collision data in the direction of travel and driver action columns. For each right-angle or rear-end collision record, the at-fault driver is identified as the one who was reported as “Disobeyed Traffic Control”, “Failed to Yield Right of Way”, “Following Too Closely”, “Improper Turn”, “Lost Control”, etc. It was also taken into account that a right-angle collision is typically more severe than a rear-end collision, and therefore are weighted heavier in the scoring process. In addition, for right-angle collision records that both drivers were reported as “Driving Properly”, both approaches on which the two involved drivers were travelling on was scored equally. Table 5 shows a summary of the scoring process for the seven candidate intersections. For each candidate intersection, the leg with the highest score (highlighted in gray in Table 6) is identified as the critical leg of the intersection.

Table 6: Scoring Results for Ranking Intersections Legs

Intersection Description	Approaches			
	NB	SB	WB	EB
Paris Street and Cedar Street	27	1	32	6
Regent Street and Beatty Street	17	7	6	19
Lorne Street and Douglas Street	-12	1	10	3
Elm Street and Elgin Street	10	17	-3	22
Municipal Road 80 and Dominion Road	-3	5	8	6
Regent Street and Algonquin Road	-9	-18	10	1
Notre Dame Avenue and Cambrian Heights Drive	-16	-3	6	-1

The ranking of the intersection legs was intended to inform the AECOM project team on how to prioritize (if needed) field investigation activities and where to focus the most. The exercise of identifying the critical legs was not intended to choose the intersection leg at which RLC is recommended for installation. The rationale is that in Ontario, the RED LIGHT CAMERA signs (see Figure 5) are posted on all approaches to an intersection which is equipped with RLC; thus, no matter on which leg of the intersection the RLC is installed, the posted RED LIGHT CAMERA signs on all approaches to the intersection are anticipated to change driver behavior on equally on all the approaches.

[8] Ontario Traffic Manual (OTM) Book 12, page 44 - 46

Figure 5: Red Light Camera Sign

4.3.2 Field Investigations

Subsequent to the completion of the office reviews, the seven candidate intersections were visited by two members of the AECOM project team over three days between Tuesday, April 10 and Thursday, April 12, 2018 when road surface was dry and for the most part there was no precipitation.

The primary focus of the field investigations was to identify any potential issue that could lead to right-angle collisions and to confirm adequacy of the available sight distances to primary and auxiliary traffic signal heads and warning signs (e.g., Traffic Signal Ahead warning sign, etc.) on all approaches to the seven candidate intersections. The field crew also assessed the status of pavement markings, possibility of sun glare, sign clutter, potential driver distraction (e.g., digital advertisement sign, etc.), lane continuity, etc.

4.4 Selection of Red Light Camera Sites

Table 7 provides a summary of the field investigations of the seven candidate intersections and the recommendations on where to install RLCs.

Among the seven candidate intersections, the following three were recommended for RLC installations:

- Paris Street and Cedar Street;

- Municipal Road 80 and Dominion Road; and
- Regent Street and Algonquin Road.

Figure 6 shows the geographical distribution of the seven candidate intersections and the three recommended intersections for the RLC installations.

For the other four intersections, a number of potential engineering solutions should be considered for implementation and assessed for effectiveness prior to revisiting them for RLC installations. The noted potential treatments in Table 7 are by no means considered comprehensive and no particular detailed assessment of their potential effectiveness has been undertaken. The potential treatments were included for consideration by the City only. Further assessment by the City should also be taken to assess the condition of pavement markings. It is essential to note that the three recommended intersections should be further reviewed / visited by the RLC vendor to ensure that feasibility of RLC installation at the recommended intersections. For example, presence of metal objects or detection loops could cause interference with RLC systems.

Table 7: Summary of Field Investigation Findings and Recommendations

Intersection	Potential Issues	Potential Treatments	Recommended for RLC
Paris Street and Cedar Street	Intersections are within close proximity for all of the three approaches, thus, potential confusion to drivers on which signal to look at.	Installation of programmable signal heads / signal timing improvements.	Yes
Lorne Street and Douglas Street	Potential mixed messages maybe given to EB and WB drivers by the rail crossing flashing red light and traffic signal head.		No
	Potential signal timing / phasing issue. It was observed that protected phase is given to the NBL movement when there are no vehicles in the NBL lane.	Improvement to signal timing / phasing.	
	EB and WB secondary traffic signal heads are slightly angled. NB traffic could see the signal indications intended for EB traffic and similarly, SB traffic could see signal display intended for WB traffic; thus, it creates potential confusion to NB and SB drivers.	Adjustment / re-alignment of the signal heads.	
Notre Dame Avenue and Cambrian Heights Drive	Insufficient Stopping Sight Distance for EB traffic.	Installation of traffic signal ahead warning sign.	No
	Vegetation foliage on the southwest corner blocks EB primary signal head.	Trimming of the foliage in the southwest corner of the intersection.	
	WB signal heads are visible to drivers on the service road and this could encourage vehicles on the service road to do unsafe back-to-back maneuvers; vehicles potentially accelerate as they approach and make a careless turn to enter the intersection but as drivers make the turning maneuver, they may not realize the signal indication has changed from green to amber, and possibly red.	Install programmable signal heads for WB traffic.	

Intersection	Potential Issues	Potential Treatments	Recommended for RLC
	Potential signal visibility issue for EB traffic during the amber interval. The yellow McDonald's sign could interfere with drivers' perception of signal indications.	Potential relocation of the McDonald's sign.	
	Potential distraction because of the digital advertisement signs in the north west and north east corners.	Review the locations and the specification of the digital advertising signs using the TAC's "*Digital and Projected Advertising Displays: Regulatory and Road Safety Assessment Guidelines* (2015)".	
	Duration of all-red interval for EB may not be adequate as eastbound through drivers slow down as they enter the intersection in preparation of upcoming turning maneuvers into the service road.	Re-visit and make adjustments (if necessary) to the signal timing plan.	
Elm Street and Elgin Street	Intersections are within close proximity in the EB and NB directions, thus, causing potential confusion to drivers on which traffic signal to look at.	Installation of programmable signal heads.	No
	Located close to an at-grade rail-road crossing. Potential mixed messages maybe given to WB drivers by the rail crossing flashing red light and green display on traffic signal head	Interconnect traffic signals with the rail crossing warning system.	
	The nearside traffic signal head could block NB primary signal head		
	Potential signal timing / phasing issue. Protected phase is given to NBL and SBL movements when there are no vehicles in the NBL and SBL lanes.	Improvement to signal timing / phasing.	
Municipal Road 80 and Dominion Drive	Vegetation foliage at the northeast corner blocks WB primary signal head.	Trimming the foliage at the northeast corner.	Yes
	Street name sign mounted on the nearside traffic pole cantilever blocks WB secondary signal head.	Relocation of the street name sign.	
Regent Street and Algonquin Road			Yes
Regent Street and Beatty Street	EB curb lane drop require last minute lane changes within a short distance to the intersection.		No
	Potential sight line issue for NBR and WBR.	Installation of no right turn on red sign.	
	Potential signal timing / phasing issue. Protected phases are given to WBL and NBL movements even when there is no demand.	Improvement to signal timing / phasing.	

5. Conclusions and Recommendations

The summary of findings and recommendations of this study are as follows:

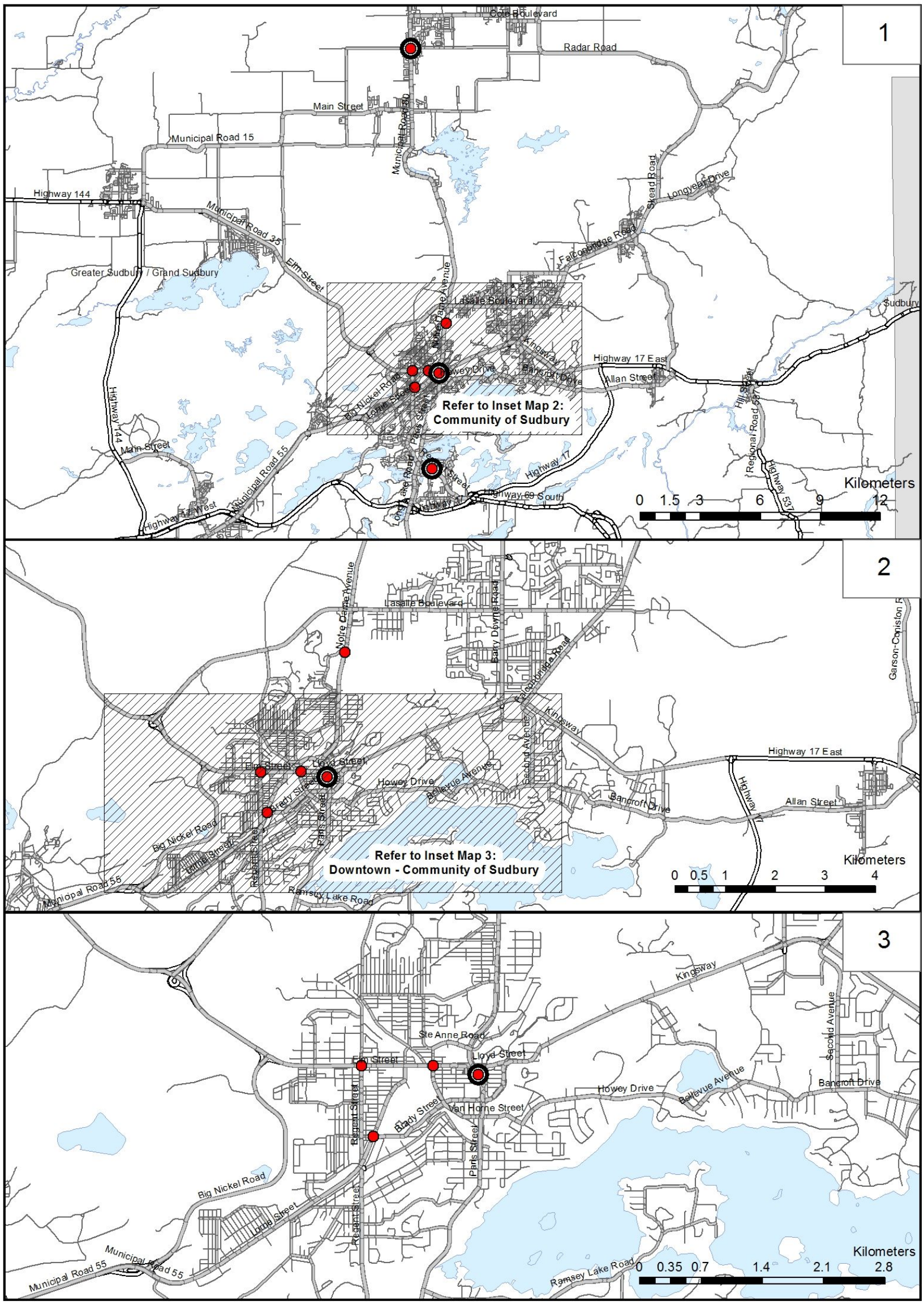
- There is a need and justification for installation of RLCs in the City of Greater Sudbury as there are a total of 55 signalized intersections that potentially benefit from RLC installations.

- The three recommended intersections for RLC installations were identified as those that would benefit the most from installation of RLCs. The three recommended intersections are:
  - Paris Street and Cedar Street;
  - Municipal Road 80 and Dominion Road; and
  - Regent Street and Algonquin Road.

- The three recommended intersections for RLC installations should be further reviewed / visited by the RLC vendor to ensure that feasibility of RLC installation at the recommended intersections.

- At four of the candidate intersections that were not recommended for RLC installations, a number of potential engineering solutions should be considered for implementation and assessed for effectiveness, prior to reconsidering RLC installation.

- The overall safety effectiveness of an RLC program could be increased by increasing the number of installation sites. In such a case, office and field reviews similar to those completed in this study should be undertaken for additional candidate sites.



City of Greater Sudbury: Red Light Camera Assessment: **Existing Conditions**

Legend

- Freeway
- Arterial
- Collector
- Local
- Candidate Red Light Camera
- Recommended Red Light Camera
- Water Body

N

Data Source: City of Greater Sudbury, Province of Ontario Open Data (c) 2018

Path: \\URS\Toronto\Markham\PRJS\Home\Users\zarelh\Projects\City of Greater Sudbury - Red Light Cameras\5. Mapping\MXD\4. City of Greater Sudbury - Future - Zoomed.mxd
Time: 3:59:54 PM Date: 4/30/2018

Figure 6: Candidate and Recommended Intersections for RLC Installations

6. References

1. Persaud, B., Council, F., Lyon, C., Eccles, K. and M. Griffith (2005). Multi-Jurisdictional Safety Evaluation of Red-Light Cameras. Transportation Research Record: Journal of the Transportation Research Board, No. 1922, Transportation Research Board of the National Academies, Washington, D.C., 2005, pp. 29-37.

2. Council, F.M., Persaud, B., Eccles, K., Lyon, C., Griffith, M.S. (2005). Safety Evaluation of Red-light Cameras. FHWA-HRT-05-048, Federal Highway Administration.

3. McGee, H.W., Eccles, K.A., 2003. Impact of Red-Light Camera Enforcement on Crash Experience. In: NCHRP Synthesis 310. National Research Council, Transportation Research Board, Washington, DC.

4. Sayed, T., de Leur, P. (2006). Photo Enforcement Traffic Safety Study. Edmonton Police Commission.

5. Sayed, T.,de Leur, P. (2007). Evaluation of Edmonton's Intersections Safety Camera Programs. Transportation Research Record: Journal of the Transportation Research Board, No. 2009, Transportation Research Board of the National Academies, Washington, D.C., 2007, pp. 37-45. DOI: 10.3141/2009-06.

6. Council, F.M., Persaud, B., Lyon, C., Eccles, K., Griffith, M., Zaloshnja, E., Miller, T. (2005). Implementing Red-Light Camera Programs: Guidance from Economic Analysis of Safety Benefits. Transportation Research Record: Journal of the Transportation Research Board, No. 1922, Transportation Research Board of the National Academies, Washington, D.C., 2005, pp. 38-43.

7. Garber, N.J.; Miller, J.S.; Eslambolchi, S.; Khandelwal, R.; Mattingly, K.M.; Sprinkle, K.M.; and Waceldorf, P.L. (2005). An Evaluation of Red-Light Camera (Photo-Red) Enforcement Programs in Virginia: a Report in Response to a Request by Virginia's Secretary of Transportation. Charlottesville, VA: Virginia Transportation Research Council.

8. Retting, R.A., Kyrychenko, S.Y. (2002). Reduction in Injury Crashes Associated with Red-Light Camera Enforcement in Oxnard, California. American Journal of Public Health 92, 1822-1825.

9. Washington, S. P., and Shin, K. (2005). "The Impact of Red-Light Cameras (Automated Enforcement) on Safety in Arizona." FHWA-AZ-05-550.

10. Solomon H., Izadpanah, P., Brady, M, and A. Hadayeghi, So You're Considering a Red Light Camera Program? Lessons and Insights from over a Decade of Camera Operation in South and Central Ontario, paper prepared for presentation at the Road Safety Policy Development - Past, Present, Future session of the 2014 Conference of the Transportation Association of Canada, Montreal, Quebec, Source: http://conf.tac-atc.ca/english/annualconference/tac2014/s-6/solomon.pdf.

Appendix A : Methodology to Develop Safety Performance Functions

Safety Performance Function for 4-Legged Intersections

For the purpose of this study, the negative binomial generalized linear model package in R statistical software was used as a tool in the development of the SPFs. For each of the dependent variables (i.e., frequency of collision impact types), SPFs with different model forms were calibrated. The candidate SPF model forms considered in this study were those that most often had appeared in the literature for signalized intersections with similar traffic volumes and number of approaches. These SPF model forms were evaluated using various criteria.

The first criterion was the presence of a counter-intuitive sign for variable coefficients ('β_1' and 'β_2'), which immediately resulted in the rejection of the model. The second criterion was the statistical significance of the coefficients. Only models for which all coefficients were statistically significant at a 95% confidence level were accepted. The third criterion was the over-dispersion parameter ('k'), which was used as an overall goodness-of-fit measure. A lower value of the over-dispersion parameter ('k') represents a better fit of the model. Finally, the fourth criterion was the mean Pearson's Chi-Square $(X)^2$ statistical measure. This measure is calculated using the following equations, where d_f represents the degrees of freedom of the model:

$$X^2 = \sum_{i=1}^{n} \sum_{t=1}^{T} \frac{[Y_{it} - E(Y)]^2}{Var(Y)}$$

Where, Y_{it} is the observed collision frequency for intersection i in year t,
E(Y) is the expected value of collision frequency corresponding to Y_{it} obtained from the SPF model,
$Var(Y)$ is the variance of collision frequency,
n is the number of intersections, and
T is the study period.

The variance of negative binomial distribution is given by the following equation:

$$Var(Y) = \mu + k\mu^2$$

Where: *y* is the random variable that represents the collision frequency at a given location at a specific period of time
μ is the Predicted collision frequency
k is the dispersion parameter

A value of ${X^2}_{mean}$ closer to 1 indicates a better goodness-of-fit of the model.

The third and fourth criteria were jointly used to assess the overall goodness-of-fit of the model. In this assignment, if the first two criteria for goodness-of-fit were satisfied (i.e., the signs for the model coefficients were all intuitive and coefficients were statistically significant) then the SPF model form with the smallest over-dispersion parameter ('k') and ${X^2}_{mean}$ statistics closer to 1 was selected. The database contained 114 intersections; among them 94 were 4-legged intersections. The selected SPF model form for 4-legged intersections in this study was as follows:

$$E(Y) = \alpha * (MajorAADT + MinorAADT)^{\beta_1}$$

Where, $MajorAADT$ is the entering AADT from the major road,
$MinorAADT$ is the entering AADT from the minor road,
α, β_1 are the model parameters

Safety Performance Function for 3-Legged Intersections

As mentioned above, the database contained 114 intersections, among them, 20 were 3-legged intersections. Statically significant models could not be found, as such, a statically significant predictive model was borrowed from the Highway Safety Manual (HCM) and calibrated for application in the city of Greater Sudbury. In this procedure, the calibration factor (C) is the total number of collisions observed in a sample from one jurisdiction divided by the sum of the predicted number of collisions using the model from another jurisdiction. The calibration factor is calculated as follows:

$$Calibration\ factor\ (C) = \frac{\sum_{i=1}^{n} Y_i}{\sum_{i=1}^{n} \hat{Y}_i}$$

Where: Y_i is the observed number of collisions for year i
$\hat{Y}_i$ is the predicted number of collisions for year i using the HCM model

The SPF model form for 3-legged intersections in this study was as follows:

$$E(Y) = \alpha * (MajorAADT)^{\beta_1} * (Minor\ AADT)^{\beta_2}$$

Where, $MajorAADT$ is the entering AADT from the major road,
$MinorAADT$ is the entering AADT from the minor road, and
α, β_1, β_2 are the model parameters.

Attachment 2

RED LIGHT CAMERA SYSTEM OFFENCE NOTICE
AVIS D'INFRACTION – SYSTÈME PHOTOGRAPHIQUE RELIÉ AUX FEUX ROUG

Form 5 *Provincial Offenses Act,* O. Reg 108/11
Formulaire 5, *Loi sur les infractions provinciales, Règl. de l'Ont. 108/11*

ONTARIO COURT OF JUSTICE
COUR DE JUSTICE DE L'ONTARIO

0460-997-13- 00
OFFENCE NO. / *N° D'AVIS D'INFRACTION*

You/*Vous*
(Name/*Nom*):
(Address/*Adresse*):

being the owner of a motor vehicle displaying
étant le propriétaire d'un véhicule automobile muni de la

Ontario number plate
plaque d'immatriculation de l'Ontario

are charged with the offence of failing to stop at a red light
êtes accusé(e) de l'infraction d'omettre de s'arrêter à un feu rouge

on the 13 day of June, 2013 at 9:10 AM
le jour de à

at the intersection of Carling Ave. and Island Park Dr.
à l'intersection de

(location / *endroit*)

in the City of Ottawa
dans le/la

(municipality / *municipalité*)

as shown in the digitized images set forth in this notice, contrary to subsection 144(18.1) and pursuant to section 207 of the *Highway Traffic Act.*
comme il est indiqué dans les images numérisées présentées dans cet avis, contrairement au paragraphe 144(18.1) et à l'article 207 du Code de la route.

The photographs taken by the red light camera system show the vehicle approaching the intersection, at which time the signal had displayed red for
Les photographies prises par le système photographique relié aux feux rouges montrent le véhicule qui s'approche de l'intersection, au moment où le feu était rouge depuis

000.5 seconds and that vehicle proceeded through the intersection when
secondes et que le véhicule a franchi l'intersection alors que

the light had been red for 001.4 seconds.
le feu était rouge depuis secondes.

I believe and certify that the above offence has been committed.
Je crois et atteste que l'infraction susmentionnée a été commise.

Signature of Officer issuing this notice:
Signature de l'agent qui délivre le présent avis:

Issuing Officer Number: 15
Numéro de l'agent qui délivre le présent avis:

Date of Deemed Service: June 28, 2013
Date de signification présumée:

PLEASE NOTE: Section 207 of the *Highway Traffic Act* provides that you, as the owner, are liable for this offence even if you were not the driver at the time, subject to limited exceptions. Neither demerit points nor a driver's licence suspension will result from your conviction for this offence. The provincial offences officer has certified that the red light camera system used in the detection of this offence is a prescribed system, used in a designated area and furthermore that it was in proper working order at the time, that the photographs obtained were recorded by that system and the traffic signals were in proper working order at the time of the offence. Certified photographs will be tendered in evidence at your trial. You must apply to the justice at trial if you wish to compel the attendance of the Provincial Offences Officer who issued the certificate of offence or who certified the photographs to be tendered at your trial.	Set Fine (*Amende fixée*): **$260.00** **Total Payable:** ***Total à payer:*** (includes set fine, applicable victim fine surcharge and costs) *(comprend l'amende fixée, la suramende compensatrice pour l'aide aux victimes applicable elles frais)* ***$325.00***	***VEUILLEZ PRENDRE NOTE :*** *L'article 207 du Code de la route prévoit que vous même, à titre de propriétaire, êtes responsable de cette infraction même si vous ne conduisiez pas le véhicule à ce moment-là, sous réserve d'exceptions restreintes. Une déclaration de culpabilité pour cette infraction ne mènera pas à l'inscription de points d'inaptitude dans votre dossier ou à la suspension de votre permis de conduire. L'agent des infractions provinciales a attesté que le système photographique relié aux feux rouges qui a servi à détecter cette infraction est un système prescrit, utilisé dans une zone désignée. De plus, il a attesté que le système était en bon état de fonctionnement à ce moment-là, que les photos obtenues ont été enregistrées par le système et que les feux de circulation fonctionnaient correctement au moment de l'infraction. Des photos certifiées seront présentées en preuve lors de votre procès. Vous devez vous adresser au juge du procès si vous désirez obtenir la comparution de l'agent des infractions provinciales qui a délivré le procès-verbal d'infraction ou qui a certifié les photos qui seront présentées en preuve lors de votre procès.*

Important - If you do not exercise one of the following options within 15 days of receiving this notice, you will be deemed not to wish to dispute the charge and a justice may enter a conviction against you. Upon conviction additional costs will be added to the total payable. If the fine goes into default, an administrative fee will be added and the information may be provided to a consumer reporting agency. Steps will be taken to enforce your defaulted fine, including refusal to issue a validation of your vehicle permit or refusal to issue a vehicle permit until the total payable and all additional costs and fees have been paid.
Important *- Si vous n'exercez pas l'une des options suivantes dans les 15 jours à compter de la réception du présent avis, vous serez réputé(e) ne pas contester l'accusation et un juge pourra inscrire une déclaration de culpabilité contre vous. En cas de déclaration de culpabilité, des frais additionnels s'ajouteront au montant total exigible. En cas de défaut de paiement de l'amende, des frais d'administration s'ajouteront et l'information pourra être transmise à une agence de renseignements sur le consommateur. Des mesures seront prises pour faire exécuter le paiement de votre amende, y compris le refus d'une demande de validation ou de délivrance de certificat d'immatriculation jusqu'à ce que le montant total exigible et tous les frais additionnels aient été payés.*

OPTION 1 – Trial Option – Ontario Court of Justice, Provincial Offences Office ***OPTION 1 – Procès*** *– Cour de justice de l'Ontario, Bureau des infractions provinciales*

NOTICE OF INTENTION TO APPEAR IN COURT: / ***AVIS D'INTENTION DE COMPARAÎTRE DEVANT LE TRIBUNAL:***

☐ I intend to appear in court to enter a plea of not guilty **at the time and place set for the trial** and I wish to have the trial conducted in the English language.

☐ *J'ai l'intention de comparaître devant le tribunal pour inscrire un plaidoyer de non-culpabilité* ***à l'heure et au lieu prévus pour le procès*** *et je désire que le procès se déroule en français.*

I request a _____ language interpreter for the trial. *Je demande l'aide d'un interprète de langue* _____ *pour le procès.*
(leave blank if inapplicable) *(à remplir s'il y a lieu)*

☐ I intend to challenge the evidence of the Provincial Offences Officer. I request that the officer attend the trial. ☐ *J'ai l'intention de contester la preuve de l'agent des infractions provinciales. Je demande que l'agent assiste au procès.* **Note:** If you **fail to notify** the court office of **address changes,** you may not receive important notices, e.g., your Notice of Trial. You may be convicted in your absence if you do not attend the trial. ***Remarque:*** *Si vous* ***omettez de prévenir*** *le greffe du tribunal de* ***tout changement d'adresse,*** *pourriez ne pas recevoir d'importants avis (par ex., votre avis de procès). Si vous n'assistez pas au procès, vous pourriez être déclaré(e) coupable en votre absence.*

Changes to your address (if applicable): / ***Changement d'adresse (le cas échéant):***

Representative's name and address: / ***Nom et adresse du représentant:***

OPTION 2 – Plea of Guilty – Submissions as to Penalty ***OPTION 2 – Plaidoyer de culpabilité – observations au sujet de la peine***

I want to appear before a justice to enter a plea of guilty and make submissions as to penalty (amount of fine or time to pay). *Je désire comparaître devant un juge pour inscrire un plaidoyer de culpabilité et présenter des observations au sujet de la peine (montant de l'amende ou délai de paiement).* **Note:** You must attend at the court office shown within the times and days shown. Bring this notice with you. ***Remarque:*** *Vous devez vous présenter au greffe du tribunal aux dates et heures indiquées. Apportez le présent avis.*

Provincial Offences Office, 100 Constellation Crescent, Ottawa ON, K2G 6J8
Monday to Friday 9 a.m -12:00 p.m, Tuesday, Wednesday, Friday 1:30p.m. - 3:00 p.m.

bureaux des infractions provinciales, 100 Croissant Constellation, Ottawa, ON K2G 6J8
Lundi a Vendredi de 9:00h a 12:00h, Mardi, Mecredi et Vendredi de 13:30 h a 15:00h

SEE ENCLOSED RETURN SLIP FOR OTHER OPTIONS / *VOIR BORDEREAU DE RETOUR CI-JOINTE POUR D'AUTRES OPTIONS*

Red Light Camera Program

Joe Rocca, P.Eng.
Traffic & Asset Management Supervisor
City of Greater Sudbury

Keir Thomas, MASc., P.Eng.
Manager, Civil Engineering
AECOM

Red Light Camera Program

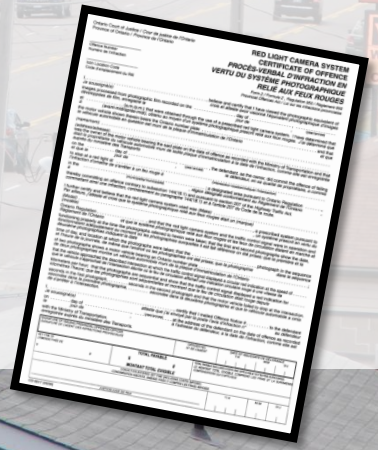
- Introduced in Ontario in 2000
- Objective is to reduce serious injuries
- Collisions from red light running tend to be more severe given speed involved
- Enforcement countermeasure designed to improve intersection safety
- Utilizes technology to supplement police presence

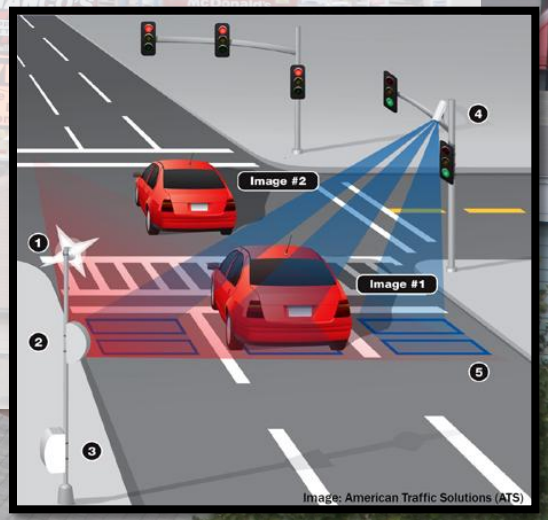
RLC Consortium

- Toronto
- London
- Ottawa
- Hamilton
- Regions of Peel, Halton, Waterloo & York

How RLCs work

- Images are taken of licence plate entering intersection on a red light signal
- Images sent and processed in Toronto
- Infraction notice sent to registered owner of vehicle
- No demerit points
- $325 fine


RED LIGHT CAMERA SYSTEM
CERTIFICATE OF OFFENCE
PROCÈS-VERBAL D'INFRACTION
VERTU DU SYSTÈME PHOTORADAR
RELIÉ AUX FEUX ROUGES



RLC Effectiveness

- Severe collisions reduced by 25%
- Rear end collisions increase 15%
- Driver behavior improves for all nearby intersections (spill over effect)
- In US study fatalities declined 35%

Study Methodology

- Potential Safety Change (PSC) estimated based on collision history and traffic volumes from single year
- Results adjusted based on collision severity
- List cross referenced with highest total collision intersections during 5-year study period
- Consideration given to “spill-over effect”

Short List – RLC Candidate Intersections

Rank	Intersection	PSC index	Total Right-Angle Collisions (2012-2016)
1	Paris @ Cedar	-4.3420	21
2	Lorne @ Douglas	-1.9754	9
3	Regent @ Beatty	-1.8621	20
4	Notre Dame @ Cambrian Heights	-1.6133	5
5	Regent @ Algonquin	-1.5837	9
6	Municipal Road 80 @ Dominion	-1.5570	10
7	Elm @ Elgin	-0.9512	16

Engineering Assessment

- Signal timing plans
  - amber and all-red intervals
- Review of as-built drawings
  - Intersection Geometry
  - Lane Widths
- Determination of ‘critical leg’

Field Investigations

- Review of site-specific conditions that may impact collision rates
  - Sight lines
  - Distractions
  - Signage
  - Driver Behaviour/Traffic Flow

RLC Recommendations

- Paris Street at Cedar Street
- Regent Street at Algonquin Road/Loach's Road
- Municipal Road 80 at Dominion Drive
- 3 others to be identified based on field review

Business Case

- Cost is $60,000 per intersection per year
  - Lease/Maintenance of Cameras
  - Infraction Processing (Toronto)
  - Vehicle Licence Information
  - Provincial Court Administration
  - Pavement markings and asphalt
  - Staff resources
  - Public Education

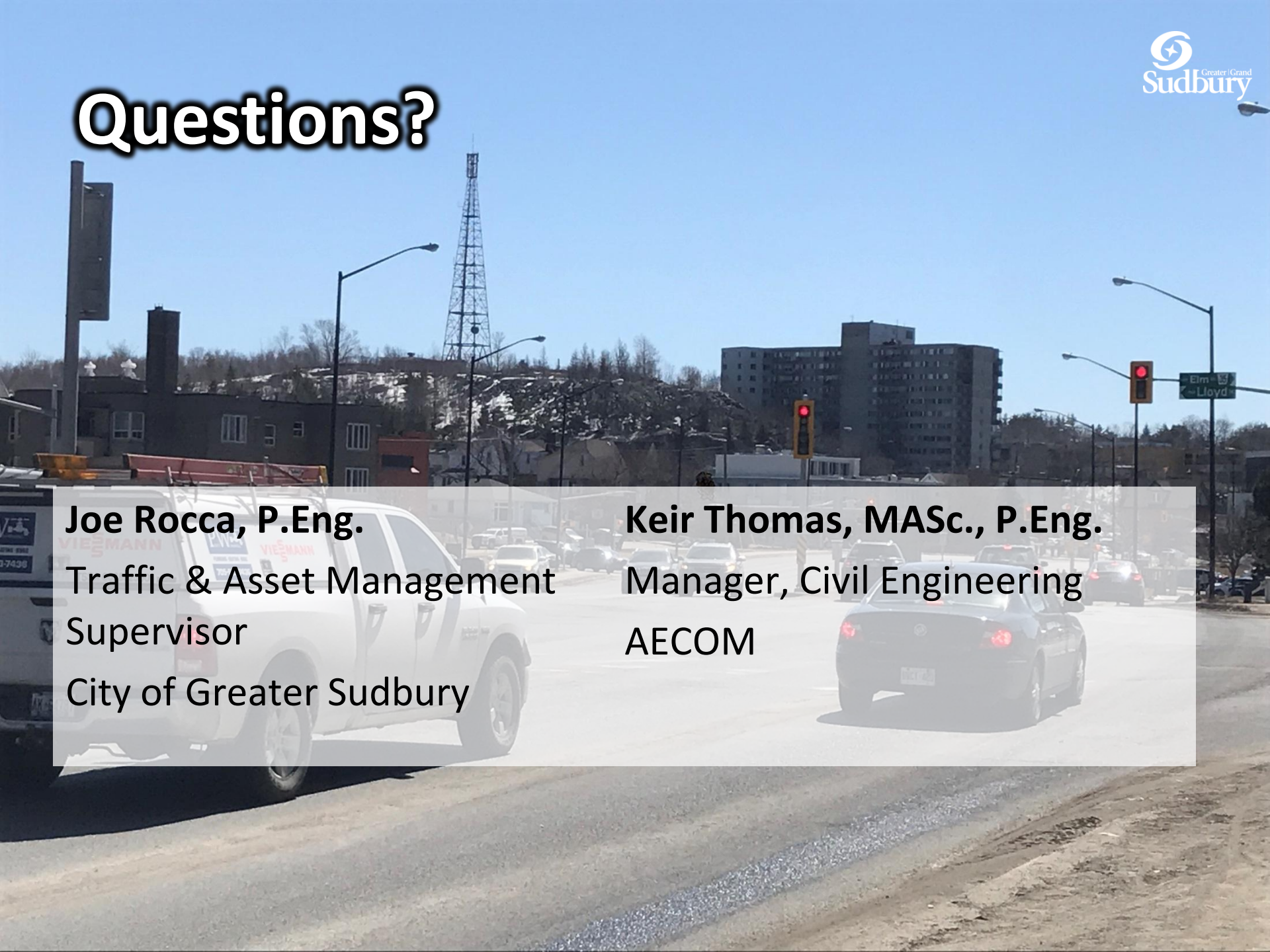
Business Case

- Net positive revenue to CGS based on estimated number of convictions
- Eight municipalities in consortium have revenues that exceed expenses
- Expected societal benefits from reduced collisions
- Revenue should decrease over time

Next Steps

- Finalize RLC sites (3 more recommended)
- Apply to become part of Ontario RLC consortium
- Agreements with Toronto Processing Centre, Ministry of Transportation
- Agreement with current vendor (Traffipax) for RLC leasing, installation and maintenance
- About 24 months to complete

Questions?



Joe Rocca, P.Eng.
Traffic & Asset Management Supervisor
City of Greater Sudbury

Keir Thomas, MASc., P.Eng.
Manager, Civil Engineering
AECOM