AN ASSESSMENT OF SURREY RCMP'S USE OF AUTOMATIC LICENSE PLATE RECOGNITION TECHNOLOGY

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Introduction

Automated License Plate Recognition (ALPR) or Automated Number Plate Recognition (ANPR)[1], as it is better known outside of North America, is a technological system that uses cameras to scan and capture alphanumerical images of vehicle license plates that, for law enforcement purposes, can be compared against a number of police databases to identify vehicles and persons of interest to the police. Initially, ALPR was designed in the United Kingdom as a way to respond to and prevent terrorism (Gaumont & Babineau, 2008; Roberts & Casanova, 2012). More recently, ALPR has become popular among police forces for its ability to detect threats to public safety, including those posed by traffic violators and prolific offenders. Using ALPR technology, police can identify drivers who, for instance, have outstanding warrants, are prohibited from driving, are driving uninsured vehicles, are driving a stolen vehicle, are speeding, or are driving a vehicle that is wanted by the police because of its connection to some type of criminal activity. Although there are many suggested public safety benefits to ALPR, it is not always clear that police forces have implemented the technology in the most efficient and effective way. As such, this report provides the results of a study regarding the application of ALPR technology by the Surrey RCMP. The results were generated using two methods; quantitative analysis of the data captured from the Surrey RCMP ALPR-equipped police vehicle and qualitative interviews conducted with Surrey RCMP traffic members who were using or managing the ALPR technology. Both approaches were used to determine how the technology was being applied and whether there could be any improvements to its use. To better contextualize the findings and subsequent recommendations, the following section provides a review of the literature on the use of ALPR.

ALPR Technology

ALPR software is a form of Optical Character Recognition (OCR) that scans images and recognizes their alphanumerical characters (Gordon & Wolf, 2007; International Association of Chiefs of Police, 2009). Often, the cameras are affixed to police vehicles making them mobile, but they may also be placed in a stationary, specific location, such as on a lamppost near the entry to a tunnel or toll bridge (Roberts & Casanova, 2012). ALPR technology uses infrared illumination to highlight and photograph a vehicle's license plate, while simultaneously eliminating extra detail, such as insurance stickers, from the plate image. The plate image is scanned by image-processing software that extracts the necessary data and transfers it to an electronically readable format that can be compared against any number of databases of interest (Gordon & Wolf, 2007; IACP, 2009; Roberts & Casanova, 2012). These databases contain 'hot lists' or a listing of license plates of interest to police for one reason or another. When an ALPR camera photographs a plate, a text file containing information on the vehicle registration number, the time and date of the scan, and the GPS location of the vehicle is created (IACP, 2009; Roberts & Casanova, 2012). In addition, a JPEG image of the

[1] This term is synonymous with ALPR and will be used interchangeably

plate is produced, and a picture or video of the vehicle occupants can be taken (IACP, 2009; Pughe, 2006). If there is an issue with the vehicle's registration or a problem with the status of the registered owner, the patrol officer is provided with this information moments after the image is captured, such as whether the vehicle was stolen, if it had been involved in another crime, or if it was uninsured (Pughe, 2006; Roberts & Casanova, 2012). At that point, the officer can decide whether to further investigate the 'hit' (Lum, Merola, Willis, & Cave, 2010).

Theoretically, the ALPR technology can scan up to 3,600 plates per hour, either from a moving/mobile or stationary/fixed platform (Pughe, 2006). However, a previous study of this technology's use in Surrey, British Columbia involving the deployment of four unmarked police vehicles equipped with ALPR technology for three weeks along 12 designated traffic corridors for nearly 24 hours a day found that a more realistic estimate was 244 plates per hour during the day and 64 plates per hour during the night (Cohen, Plecas, & McCormick, 2007). The reduction in the number of plates read was due to limitations resulting from real-life road conditions, including primarily the volume of traffic, but also weather conditions and the presence of medians that blocked the cameras' ability to scan oncoming vehicles (Cohen et al., 2007). Still, the number of plates typically scanned by ALPR technology in a given hour remains much more than can be scanned manually by a patrol officer and does so in a way that increases police officer and public safety by not requiring the member to take their eyes off the road to manually enter license plate information. In effect, ALPR automates a process commonly employed by police officers to detect threats to public safety, thereby increasing efficiencies.

However, although the number of plates scanned by ALPR can be quite high, the actual hit rate, or the frequency of a successful match between a scanned license plate and a database of interest, is often low. Schuurman (2007) tested ALPR technology in parking lots in Surrey, British Columbia, and found a 1.6% hit rate. Similarly, Cohen and colleagues (2007) tested this technology in an applied study in Surrey using mobile deployment of ALPR and reported a 2.2% hit rate. These studies discovered that the hit rate depended upon several key factors, primarily the volume of traffic and the number of databases used for license plate comparison (Cohen et al., 2007).

Furthermore, a 'hit' does not necessarily always produce an actionable event. For instance, the camera may misread the image of the plate resulting in an incorrect match between the plate and the database. In Cohen's previous study (Cohen et al., 2007), an 8% error rate was identified, most commonly for uninsured drivers who may specifically try to conceal their plate information to avoid detection. A second reason is that a hit may be generated for a non law-enforcement reason that does not provide the police officer with the grounds to execute a traffic stop. For instance, if ALPR reads the plate of a known sex offender or a person with a history of suicide attempts, although the member may be notified that a hit occurred, they have no legal grounds upon which to stop the driver (Denham, 2012). A third reason that a successful hit may not generate an actionable event is that someone other than the registered owner may be driving the vehicle. In these cases, although the vehicle's plate may be correctly read and associated to an unlicensed registered owner, the person driving the vehicle may have a valid license. Unless they commit some other form of traffic violation, such as running a stop sign or driving under the influence of alcohol, the police officer is prevented from issuing a ticket or executing an arrest. In a similar limitation, obsolete hits are those that were legitimate at an earlier time of day, but are no longer relevant, yet

have not been removed from the database. An example of this type of occurrence is a vehicle that was uninsured in the morning when the database information was loaded into the police vehicle, but has been subsequently insured by the time it was scanned by the ALPR system (Denham, 2012).

Police Applications of ALPR

ALPR technology serves two broad law enforcement purposes; immediate interdiction of wanted persons or vehicles and the longer-term investigation of other crimes or criminals (Perin, 2011). Within these categories, there are a wide range of applications for plate recognition technology, including the identification of potential terrorists, to assist the police with crowd control, as part of the response to trying to locate missing children (Amber Alerts) or people, to assist in locating vehicles or people to "be on the lookout" for (i.e. BOLO alerts), to detect and recover stolen vehicles, to enforce traffic laws and regulations, to collate information for investigative or information sharing purposes, or to monitor the movements of persons of interest (Canadian Press NewsWire, 2006; Custers, 2012; Gierlack, Williams, LaTourrette, Anderson, Mayer, & Zmud, 2014; Griffith, 2014; IACP, 2009; McClellan, 2004; Ozer, 2010; Roberts & Casanova, 2012; Shumate, 2009; Watson & Walsh, 2008).

Two recent American law enforcement surveys determined that the most commonly used application of ALPR was to detect stolen vehicles (Lum, Merola, Willis, & Cave, 2010; Roberts & Casanova, 2012). Nearly all (91%) of responding law enforcement agencies in Lum and colleagues' (2010) national survey used ALPR for this purpose. Roberts and Casanova's (2012) research found that two-thirds of local, state, and tribal law enforcement agencies using ALPR in the United States used it for this purpose; importantly, two-thirds of these agencies reported increases in recoveries of stolen vehicles as a result of using ALPR when compared to manual detection. Similarly, an evaluation of ALPR in Arizona by Taylor, Koper, and Woods (2012) determined that the use of ALPR increased the detection and recovery of stolen vehicles and generated more arrests than manual plate checking. However, despite the successful detection and recovery of stolen vehicles among these American agencies, research in Canada has been less positive regarding the application of ALPR to stolen vehicles. In the previous study by Cohen et al. (2007) in Surrey, less than 1% of all hits were for stolen vehicles. A major reason for this was that hot lists were generated only once in the early morning and were not updated for the next 24 hours. As stolen vehicles are most likely to be detected later in the day, once the lawful owners of the vehicle left their house and determined that their vehicle had been stolen, the police were typically operating with old information and were unlikely to detect stolen vehicles before they were disposed of (Cohen et al., 2007; Taylor et al., 2012).

The second most common reported use of ALPR was to detect traffic violators, for instance, those who were driving while unlicensed or prohibited, or who were driving an uninsured vehicle (Roberts & Casanova, 2012). Although ALPR can also be used to detect drivers with unpaid parking tickets, this was not a very popular application of the technology (Lum et al., 2010). However, because prohibited/suspended drivers or those driving without licenses or insurance are more likely to be involved in motor vehicle collisions, particularly hit-and-runs (Dalby & Nesca, 2008; Harrison, 1997; MacLeod, Griswold, Arnold, & Ragland, 2012; Michalowski, 1975), facilitating their

detection by police through automated scanning is more common. In this application, the license plates of vehicles and persons of interest created the hot list that was provided by motor vehicle branches for comparison against plates scanned by ALPR cameras.

Unlike in the application to stolen vehicles, large numbers of traffic violators are typically detected by ALPR. In an evaluation of ANPR in the United Kingdom, one-quarter of all arrests made as a result of a 'hit' were for disqualified, uninsured, or prohibited drivers (PA Consulting Group, 2004). In a Surrey, British Columbia study by Schuurman (2007), an unmarked ALPR patrol vehicle drove through 31 parking lots scanning the license plates of parked cars and comparing the images to hot lists generated through Canadian Police Information Centre (CPIC) and Motor Vehicle Branch (MVB) databases. In total, 21,876 license plates were scanned and 1.6% of these plates resulted in a 'hit' (Schuurman, 2007). Over two-thirds (70%) of hits were for unlicensed drivers, while the remaining were for uninsured vehicles (24%), prohibited drivers (5%), and stolen vehicles (1%). Similarly, in Cohen and colleagues' (2007) test of ALPRs application in Surrey, British Columbia in October 2006 using hot lists provided by CPIC and the MVB that were approximately 24 hours old, the majority of hits were for unlicensed drivers (70%), whereas one-fifth (20%) were for uninsured vehicles, less than one-tenth (8%) were for prohibited drivers, and almost none (1%) were for stolen vehicles. The overall hit rate was 1.5%, although this varied depending on where and when ALPR was deployed in the city (Cohen et al., 2007).

Another common application of ALPR is in criminal investigations. Roberts and Casanova (2012) found that for 70% of American law enforcement agencies, one of the many applications of their ALPR systems was for general investigations, and, for one-quarter of the responding agencies, ALPR was used primarily for this purpose. In effect, in addition to detecting and recovering stolen vehicles, ALPR can also be used to monitor the movements of persons of interest or to track vehicles entering locations of interest. With regards to the former, ALPR could be used to monitor the movements of offenders with court ordered geographical restrictions, such as domestic violence offenders who have a no contact order against the victim, or sexual offenders who are prevented from being within a certain distance from schools (IACP, 2009; Perin, 2011). If a license plate is flagged using ALPR, a police officer can quickly query that plate in their criminal databases to determine what restrictions the individual has on their movement and whether they are violating that condition. ALPR could also be used to check the alibis of suspects (Gierlack et al., 2014; Perin, 2011). In another application, hot lists of license plates associated with other persons of interest, such as wanted offenders, gang members, or suspected terrorists, could be used to track their movements, locate them, or generate further investigative leads (Gierlack et al., 2014; IACP, 2009; Ozer, 2010; Roberts & Casanova, 2012). By engaging in intelligence-led deployments that involves deploying ALPR based on crime prevention theory, such as sending ALPR cars to identified high crime areas or neighbourhoods with a disproportionate number of prolific offenders, ALPR can effectively detect vehicles associated to persons of interest to the police (Ozer, 2010).

With respect to the latter application of tracking vehicles entering locations of interest, ALPR can be used to monitor the license plates of vehicles entering crime hot spots or approaching known locations of interest, such as drug houses or bars frequented by gang members (Ozer, 2010; Perin, 2011; Roberts & Casanova, 2012). Using a network analysis software application, such as I2 or IBM's Identity Insights, this information could be used to identify associates of persons of interest.

By mining ALPR data, police analysts could identify crime trends, such as a series of related break and enters that can be associated to a single vehicle license plate (Gierlack et al., 2014). However, as will be discussed below in this report, privacy restrictions can limit the ability of police to mine non-hit data for pattern analysis.

Aside from generating investigative leads, ALPR can also be used to detect other forms of criminal activity. Motor vehicle theft itself can facilitate other criminal activities, including break and enter, armed robbery, and drug-related offences (Canada NewsWire, 2007; Schuurman, 2007). For instance, an offender may steal a vehicle for use in the commission of additional offences, such as a hit-and-run, or to assist in the transportation of stolen property. Alternatively, drug offenders may steal items from within cars, and may also steal the car to obtain money to purchase drugs (Schuurman, 2007). Thus, detecting stolen vehicles using ALPR may also uncover the commission of other associated crimes. In addition to crimes associated with motor vehicle theft, ALPR may detect other ongoing crimes related to driving. For instance, ALPR can be utilized at impaired driving checkpoints, where the ALPR-equipped vehicle is placed ahead of the checkpoint to scan license plates of vehicles approaching the checkpoint and provide guidance to officers regarding which vehicles may be more high risk (Custers, 2012; Neville, 2009). As such, ALPR has the capacity to reduce criminal activity in addition to regulating traffic issues and increasing public safety.

Furthermore, research suggests that those who consistently violate traffic regulations are more likely to have a criminal history (Cohen, McCormick, & Haarhoff, 2014; Rose, 2000). Chenery, Henshaw, and Pease (1999) found that one-third of people who illegally parked in disabled parking spots had a previous criminal record, nearly half (49%) had a history of traffic violations, and one-fifth (21%) were of immediate police interest or were known or suspected of having involvement with other criminal activities (18%). In this study, registered owners of vehicles who were of immediate interest to the police, who had a criminal record, whose vehicle had a history of traffic violations, whose vehicle had been used in the past for criminal activity, or who had a current vehicle illegality were all significantly more likely to be parked illegally than legally (Chenery et al., 1999). Knowing this, using ALPR to generate a reason to initiate a traffic stop on a traffic violator and subsequently checking for their name in a police database could result in the detection of a wanted offender. Furthermore, the fact that ALPR scans many more plates than a police officer can do manually means that the technology has the potential to find many more offenders and generate more arrests than a police officer who conducts manual license plate checks during routine patrols. In the previously mentioned United Kingdom evaluation, more than one-third of all arrests resulting from an ANPR hit were for crimes, including theft/burglary (17%), theft from or of a vehicle (10%), or drug offences (8%) (PA Consulting Group, 2004). More recently, in Northampton, England, nearly one-third (30%) of all arrests were associated with the work of ANPR intercept teams – teams of police officers assigned to chase down vehicles that generate a 'hit' (Dean, 2010 as cited in Armstrong et al., 2010). Similarly, an evaluation of the Cincinnati Police Department's ALPR data revealed an increase in arrests when using ALPR over traditional policing methods; importantly, this unit made more arrests than the traditional policing units while having fewer officers, and ALPR was found to be a cost effective policing and crime prevention strategy (Ozer, 2010). Thus, ALPR can increase police efficiency and effectiveness in apprehending criminals (Lum

et al., 2010).[2] This potential is obviously increased if the lists of people and vehicles of interest to the police include license plates of wanted and prolific offenders, in addition to traffic violators.

A perceived benefit of ALPR is its ability to increase productivity. In fact, two evaluations of the use of ANPR with police forces in the United Kingdom documented increased officer productivity and a ten-fold increase in arrests (PA Consulting Group, 2003; 2004). The national American survey by Roberts and Casanova (2012) found that half of the responding agencies reported an increase in productivity and 55% reported an increase in arrests. Although the UK researchers suggested the increased productivity was due to officers spending more of their time investigating hits and less time waiting for hits after typing in a plate number, presumably the increase in productivity was also due in part to the greater number of plates that were scanned than typically would be when officers were required to enter the plates manually. ALPR offers further benefits to productivity in unfavourable environmental conditions. Given its use of infrared technology to capture plate images, ALPR theoretically operates consistently well in a variety of environmental conditions, including poor weather and during the night, whereas an officer's ability to read license plates is more difficult in those particular situations (Custers, 2012; IACP, 2009; Roberts & Casanova, 2012; Russell, 2009).

That said, the capacity to investigate the hits generated by ALPR may somewhat limit the technology's success. In the original ANPR evaluation in the UK, the researchers found that police were only able to respond to 13% of generated hits (PA Consulting Group, 2003). In effect, the technology can generate many more hits than police can respond to. As a response, the United Kingdom funded dedicated intercept teams composed of seven to twelve officers assigned to chase down vehicles that generated a hit (Roberts & Casanova, 2012). Importantly, when police do act on a hit, they are often able to take action against the driver and the vehicle's other occupants. For instance, nearly two-thirds (61%) of the stops made in the original ANPR evaluation resulted in some police action taken against a vehicle occupant, such as making an arrest. Yet, arrests may generally be less common than other actions, such as writing a ticket, since in the second ANPR evaluation, an arrest was made in only approximately 7.5% of all vehicle stops, whereas over one-quarter (27%) of all stops resulted in a ticket (PA Consulting Group, 2004). Similarly, an evaluation of ALPR in Cincinnati found that after reading more than 300,000 plates and identifying more than 8,000 vehicles of interest, around 300 suspects were arrested, an overall rate of 1% (Neville, 2009). Still, there is no doubt that ALPR technology has been used successfully in a multitude of applications from enforcing traffic safety to furthering criminal investigations.

Unfortunately, one area where ALPR has not been found to be as effective is in achieving specific or general deterrence. A potential benefit of an ALPR program is that, as the public becomes more aware of its use, their participation in activities likely to be detected by the program would decrease. As ALPR is generally used by police agencies to detect stolen vehicles (Lum et al., 2010; Roberts & Casanova, 2012), its use should theoretically reduce future participation in this activity specifically, as well as generally through reducing crimes associated with auto theft, such as other

[2] See Armstrong et al., 2010 for a discussion of cases where information collected using ALPR contributed positively to other criminal investigations.

property and drug offences. However, two separate randomized controlled experiments testing ALPRs deterrent effect in crime hot spots failed to detect any reductions in crime (Lum, Hibdon, Cave, Koper, & Merola, 2011; Taylor et al., 2012), while a more recent experimental study by Koper, Taylor, and Woods (2013) found that ALPR use in targeted hot spots temporarily reduced drug crimes, although these offences appeared to have been displaced elsewhere.

There are several possible reasons for the overall lack of effect that ALPR has on deterring crime. First, deterrence takes time to achieve, and the study follow-up periods perhaps were not long enough to properly assess the deterrent effects of ALPR use. For instance, Taylor and colleagues' (2012) study on the deterrent effect of ALPR on auto theft only examined the effect over a two week period, while the study by Lum et al. (2011) observed the deterrent effect over a three month time period. However, Koper et al. (2013) and Taylor, Koper, and Woods (2011) tested the deterrent effect of ALPR initially over 30 weeks, while Taylor et al. (2011) then extended their observation over an additional 18 week period, which should be a sufficient amount of time for deterrence to occur. However, both studies found essentially no effect on auto theft and only a minimal effect on drug crimes.

Another reason why ALPR may not have had a deterrent effect on crime is that typical hot spot policing achieves deterrence through a saturation effect, where a known criminal hot spot is temporarily inundated with police. However, given that many agencies only operate one set of ALPR cameras (Lum et al., 2010), saturation often cannot be achieved in the same manner as other hot spot policing strategies (Lum et al., 2011; Taylor et al., 2012). Furthermore, although Koper et al. (2013) and Taylor et al. (2012) conducted their study using four ALPR-equipped police vehicles, the majority of the vehicles were covert/unmarked and, therefore, may not have been as effective in achieving deterrence as a marked police vehicle.

A third explanation for the lack of deterrence is that the public may not be familiar enough with ALPR technology to know either what it is or that their local police force is employing it (Lum et al., 2010; Watson & Walsh, 2008). If the public is generally unaware that police are using cameras to scan license plates, they cannot be deterred from participating in the targeted behaviours. Thus, promoting the use of ALPR among the public may increase its deterrent effect. That said, Lum and colleagues (2010) conducted a community survey regarding ALPR use and found that only one-quarter (26%) of the public indicated that they would not participate in certain behaviours (parking or traffic violation) if they knew that the police were targeting it through ALPR technology. In fact, this proportion of people would likely be lower in reality, particularly if the public were made aware that there was only a small likelihood of being in the same time and place as the vehicle operating the technology.

A fourth potential reason for the failure of ALPR to have a deterrent effect on stolen vehicles specifically may have to do with the geographical nature of the crime. A vehicle is stolen in one location and then driven to at least one other location; thus, stolen vehicles are not ideal for hot spot policing. That said, they could be subjected to hot "*route*" policing (e.g. Taylor et al., 2012), given that previous research has found that stolen vehicles are often recovered just a short distance from where they were stolen (Lu, 2003; Lu & Thill, 2003; Lum et al., 2011).

Yet, despite the overall lack of deterrence, the studies conducted with ALPR have generally found that it does substantially increase the number of plates read and that it is more effective in detecting violations of interest than using the traditional manual process of checking plates (e.g. Cohen et al., 2007; Taylor et al., 2012). However, its effectiveness could be enhanced by the addition of more sources of interest, including the license plates of members of the public with an existing warrant for their arrest, of repeat or prolific offenders, of known frequently impaired drivers, or of offenders with current court ordered restrictions on their mobility (Koper et al., 2013; Lum et al., 2010). Of course, expanding the types of information related to automated license plates scans could lead to concerns among the public regarding the potential for certain applications of ALPR to infringe upon their personal privacy (Lum et al., 2010).

Privacy Concerns

Despite ALPRs obvious utility in promoting public safety, its use has been somewhat limited because of privacy concerns (Denham, 2012; IACP, 2009; Martinez, 2013). Concerns over privacy have led to its prohibition in at least one American state and prevented a recent Department of Homeland Security initiative to develop a nationwide database in the United States (Griffith, 2014). Closer to home, a privacy investigation into the use of ALPR by the Victoria Police Department acknowledged that the police were generally using the program appropriately, but made several recommendations limiting the application of the program (Denham, 2012).

Privacy concerns have been expressed in three main ways: the appropriateness of police collection of personal information in the event that no wrongdoing has occurred; the nature of information used to generate the hot list; and the retention and use of non-hit plate data.

THE COLLECTION OF PERSONAL INFORMATION

The International Association of Chiefs of Police (IACP) argued that it was not the capturing of license plate data that was the source of public concern because this process does not specifically identify a person. Rather, it was the secondary investigative process where the plate information was compared to a database of interest that was the concern (IACP, 2009). Thus, in their view, the use of ALPR technology was not the issue. However, Denham (2012) disagreed, citing several legal cases in Canada where license plates have been determined to constitute personal information. Her analysis found that because police had the ability to associate the license plate to a particular individual (the registered owner) and to information about that specific individual, such as their address, license plates were considered personal information subject to provincial privacy laws. Similarly, the federal *Privacy Act of Canada*, which, as a federal government institution, applies to the RCMP, identifies personal information as “information about an identifiable individual that is recorded in any form”, including, in subsection 3(c), “any identifying number, symbol, or other particular assigned to the individual”.

Although license plates constitute personal information in Canada, the provincial legislation gives law enforcement agencies the right to collect such personal information for law enforcement purposes, which Denham (2012) interpreted to mean information that alone would be sufficient to

generate an investigation (Denham, 2012). Thus, under the British Columbian *Freedom of Information and Protection of Privacy Act*, the "collection of license plate number, license plate, and vehicle image, geographic location, and time of scan for all vehicles scanned by the ALPR system is authorized" for police (Denham, 2012: 20). Similarly, section 4 of the federal *Privacy Act* allows personal information to be collected by government agencies if it relates directly to "an operation program or activity of the institution". Thus, the RCMP is able to collect license plate information in the context of upholding public safety through vehicle and traffic enforcement.

THE NATURE OF THE HOT LIST

A second privacy concern involves the nature of the hot list used by the police. Generally, ALPR's use has been widely accepted in its most common application to detect and recover stolen vehicles, and many members of the public also appear to support its use in detecting traffic violators (e.g. Lum et al., 2010). These are activities that constitute immediate threats to public safety and which alone can generate an investigation resulting in some form of police action, such as writing a ticket or making an arrest. However, it may be more difficult for police to successfully argue the need to identify other persons of interest, such as those with a known history of violence towards the police or who have failed to make child support payments (Denham, 2012; Lum et al., 2010). As an officer cannot take immediate action towards these individuals, Denham (2012) argued against the legitimacy of including them in an ALPR searchable hot list. As a result of her investigation into the Victoria Police Department's use of ALPR, Denham (2012) specifically recommended that police reduce their hot list categories of interest to those serving a law enforcement purpose, such as prohibited drivers, rather than those providing more contextual information, such as previous issuance of a firearms certificate.

THE RETENTION OF NON-HIT DATA

Much of the ongoing privacy debate focuses on the retention of the collected information generated by ALPR. This information can include the image of the license plate, the date and time the image was taken, the GPS location, and whether or not the plate was associated to a hot list of target vehicles (Roberts & Casanova, 2012). Regardless of hit status, this information can be stored in a police database for a period of time. The concern is that non-hit data is being retained about people who are not known to have committed an infraction of the law (Roberts & Casanova, 2012). It should be noted that, in the case of non-hits, other personal information, such as the address of the registered owner of the vehicle and their driving history, is not automatically generated by ALPR and not kept in this database. However, the fact that retention of non-hit data may reveal the personal driving habits of individual citizens, such as where and when they have been to certain locations, has led to some privacy concerns (e.g. Griffith, 2014; IACP, 2009; Roberts & Casanova, 2012). It should be noted, however, that this particular concern is more strongly associated with fixed cameras as they are much more likely to detect routine movement of a particular vehicle along a particular stretch of road, whereas mobile cameras are less likely to regularly come into contact with the same vehicle, unless ALPR was used to patrol parking lots where particular vehicles may park on a regular basis (IACP, 2009).

Retained ALPR data can enhance police investigations (IACP, 2009). Should a serious crime occur, such as a homicide, sexual assault, or an act of terrorism, police may be able to use previously collected ALPR data from that particular location to identify possible suspects, to challenge an alibi, or to clear a potential suspect (Neville, 2009). As an example, a partial license plate provided by a witness to a break-and-enter could be compared against retained ALPR data as part of the investigatory process; if a vehicle with a similar plate number was in the area of the crime around the time and date the offence occurred, the police have generated useful intelligence that could contribute to solving the crime (Armstrong et al., 2010). Data collected through ALPR could also be used to link a series of crimes. For instance, if a series of related break and enters occurred, crime analysts could use ALPR data to determine whether a particular vehicle was in more than one of those locations of interest (IACP, 2009). Analysing retained data can also help police be more proactive. For instance, by analysing the patterns of vehicles attending locations of interest, crime analysts may be able to detect potential terrorist attacks (IACP, 2009).

Given concerns over the police conducting "fishing expeditions", generally, there is only a short period of time to use ALPR information for investigative purposes before the database is purged. However, currently, there is no standard retention period for ALPR data. Instead, the data retention period is determined by individual law enforcement agencies (IACP, 2009). As a general rule, hit data typically appears to be retained for longer periods of time than secondary data. In Canada, while hit data may be retained for two years[3] (Gaumont & Babineau, 2008), based on a review of global practices in ALPR data retention, Armstrong, Czeck, Franklin, and Plecas (2010) recommended a retention period of one year for non-hit data. Of note, in 2012, British Columbia's Privacy Commissioner recommended that non-hit data be immediately deleted once the ALPR system determined the plate did not match a hot list, as such personal information no longer serves a law enforcement purpose (Denham, 2012) and, correspondingly, jurisdictions such as the E-Division RCMP in British Columbia do not retain non-hit data. Similarly, some countries, such as Germany and Holland, several states in Australia, and the province of Ontario do not retain any non-hit data (Armstrong et al., 2010; Canadian Press, 2013; Custers, 2012; Denham, 2012). In contrast, while agencies in New York State can retain their non-hit data indefinitely, agencies in other states, including Arizona, California, Maine, and the District of Columbia retain non-hit data for periods between 21 days and three years, while others, such as New Jersey, can retain the data for five years (Armstrong et al., 2010; Griffith, 2014; Roberts & Casanova, 2012). Overall, Roberts and Casanova (2012) found that 5% of American law enforcement agencies responding to their national survey did not retain any data, whereas nearly half either kept data up to one-month (18%) or between two and six months (18%). Slightly more than one-tenth (13%) kept their data indefinitely. In the UK, data is generally retained for two years, but can be extended to six years with an investigative reason (Armstrong et al., 2010).

[3] Of note, in Ontario, where the Ontario Provincial Police is currently expanding their use of ALPR from four cars to 31 cars (Carruthers, 2013), hit data appears to be retained up to five years (Quan, 2014). In Calgary, the Calgary Parking Authority uses ALPR to scan license plates and has a database of all scanned plates going back seven years (Quan, 2014).

The Use of ALPR

Despite the aforementioned privacy concerns, ALPR has become a popular law enforcement tool used in more than 40 countries (Armstrong et al., 2010). In the United Kingdom, ANPR now forms a large component of the intelligence network (Armstrong et al., 2010), as 3,000 cameras are situated across the United Kingdom, both stationary (roadside) and mobile (mounted on police vehicles), where they scan up to 5 million license plates per day (Pughe, 2006). In 2001, all 43 police forces in England and Wales were provided with vans equipped with ANPR technology and computers able to store ANPR information in real time (Pughe, 2006).

In North America, the IACP passed a resolution in 2007 that "strongly encouraged the U.S. Congress to fully fund license plate reader and related digital photographing systems..." (IACP, 2009: 2). As of 2009, nearly one-quarter (23%) of a random sample of 305 American policing agencies had implemented ALPR technology (Roberts & Casanova, 2012). Given its cost, it was not surprising that larger agencies were more likely to report using ALPR (50% of agencies with 501-1,000 sworn officers and 80% of agencies with over 1,000 sworn officers) than smaller agencies (23% of agencies with 500 or fewer sworn officers). Overall, 95% of agencies were using mobile units, and the most common application was to detect and recover stolen vehicles (83%). Although not necessarily the primary purpose of ALPR, nearly three-quarters (70%) of responding agencies used ALPR for general investigation purposes, while half used it for vehicle and traffic enforcement. Other applications of ALPR included crime analysis (33%), narcotics (28%), gang enforcement (20%), and smuggling (10%) (Roberts & Casanova, 2012). Of note, 43% of responding law enforcement agencies uploaded their hot lists once per day, meaning that they were typically operating on historical data, while 28% updated their lists at shift change, thus generating between two to three hot lists per day (Roberts & Casanova, 2012).

In 2010, Lum and colleagues conducted a national American law enforcement survey and found that 37% of 200 large police agencies (100 or more sworn officers) were using ALPR, while another one-fifth were planning to purchase it within the next few years. In this study, the most commonly reported use of ALPR was to detect stolen vehicles or stolen plates (91%), whereas nearly half used ALPR either for traffic safety (40%) or for investigatory purposes (40%). Moreover, 23% of large American police agencies used ALPR to monitor vehicles entering high-crime locations (i.e., hot spots), while only 17% used it for security purposes around high-risk locations (Lum et al., 2010). In the vast majority of agencies (83%), the cameras were installed on a marked police vehicle; however, keeping in mind some agencies operated more than one set of cameras, 40% of agencies also reported that ALPR was installed on an unmarked vehicle. Interestingly, only 26% of these agencies reported the use of ALPR 24 hours per day; more often (40% of respondents), ALPR was deployed for only several hours per shift.

More recently, a survey with major American, Canadian, and United Kingdom cities found that virtually all of the responding police forces (25 of 27) used ALPR in some capacity (MCCA Legal Advisors' Committee, 2013). Although not one of its most successful endeavours, nearly all agencies reported that they used the technology to detect and recover stolen vehicles. The second most common use was for crime intelligence purposes; essentially using ALPR equipped vehicles to patrol high crime areas to collect data to be used to identify and track crime trends. The third most

common reason for ALPR technology use was to assist in searching for wanted persons, such as in cases of Amber Alerts. Approximately, three-quarters (77%) of agencies retained their ALPR information; however, half discarded it within one year of collection. Of note, only 45% had an explicit policy in place concerning ALPR related issues, such as a data retention policy (MCCA Legal Advisors' Committee, 2013).

The Use of ALPR in British Columbia

In Canada, ALPR is used in British Columbia, Alberta, Manitoba, Ontario, Quebec, and Saskatchewan (Armstrong et al., 2010; Quan, 2014). In British Columbia, there are 41 ALPR equipped cars, seven of which are operated by four municipal police departments (Victoria, Vancouver, Saanich, and Abbotsford). The RCMP operates the remainder (Denham, 2012). The RCMP first brought ALPR to British Columbia in 2006 with the intention of using it to detect stolen vehicles (Denham, 2012; Gaumont & Babineau, 2008). In 2010, the program was expanded to detect multiple forms of traffic violations, including vehicles operated without insurance and individuals who were prohibited from driving or were driving without a valid license (Denham, 2012). A less common use is the rare case of an Amber Alert where the license plate of a vehicle associated with an abducted child is released to the public (Ministry of Public Safety and Solicitor General, 2010).

ALPR operations in British Columbia differ from the United Kingdom in two major ways. First, in British Columbia, the cars do not use real-time data, but rely on data that is uploaded approximately every 24 hours. The Insurance Corporation of British Columbia (ICBC) and the Canadian Police Information Centre (CPIC) provide the data that forms the hot lists. Second, generally there are no dedicated "strike force" style teams using ALPR; instead, the ALPR equipped vehicle is used as a stand-alone tool. In effect, the ALPR-equipped marked police vehicle will drive through a city scanning license plates and, if a hit occurs, that police vehicle will investigate and respond to the hit.

Originally, the hot lists of interest to police in British Columbia included seven categories: stolen vehicles, wanted persons across Canada, wanted persons across British Columbia, prohibited or suspended drivers, uninsured vehicles, unlicensed drivers, and other pointer vehicle, which included eleven sub-categories of interest, such as those who have made previous suicide attempts, missing persons, parolees, known associates of persons of interest, and persons under surveillance (Denham, 2012). However, Denham's investigation into the use of ALPR by the Victoria Police Department recommended amending the final category of information given that much of it was not relevant information to the stated purposes of the ALPR program. Thus, the sources of information now available in the hot lists are limited to prohibited or unlicensed drivers, uninsured or stolen vehicles, Amber Alerts, and other alerts from CPIC related to law enforcement purposes, such as an outstanding provincial or a national warrant.

Current Study

As noted, the intention of this report was to explore how the Surrey RCMP Traffic Services Unit use ALPR and to make any recommendations that might improve its utility and effectiveness. To this

end, this study used both quantitative data analysis and qualitative interviews. The quantitative component of the study analyzed data from every ALPR read recorded over a two year period between March, 2012, and February, 2014. The data included information on the date and time of the read and, in some cases, its location (XY coordinates). The data also included information on the nature of hot list hits and on the dispositions associated with each hit. In addition to the quantitative analysis, qualitative interviews were conducted with four members of Surrey's traffic services unit regarding the use of the ALPR technology. These members had varying degrees of experience using ALPR technology, including regular current use, frequent past use, infrequent current use, and training only. The interviews lasted between ninety minutes and two hours in length and focused on the nature, extent, strengths, and limitations of ALPR use in Surrey. In addition, the interviewer participated in a ride-along session where the use of ALPR technology was demonstrated live.

Results: Data Study

DESCRIPTIVE STATISTICS

Between March 2012 and February 2014, the Surrey RCMP ALPR system read 114,847 license plates (reads). As shown in Table 1, not all of the reads could be used in the current analysis. For example, a small percentage of cases involved misread license plates, repeat hits, or operator error (0.6%). These cases were removed from the analysis producing a valid sample of 114,192 reads. Table 1 also indicates that in 236 cases, a hit did not have a corresponding disposition. These were instances of operator error, as a disposition should be recorded for every hit. However, we chose to retain these cases in the analysis. They were simply treated as "missing disposition." In total, the 114,192 reads generated 1,770 hits. This represents a "hit rate" of 1.55%, which is consistent with Schuurman's (2007) application of ALPR in parking lots in Surrey, although somewhat lower than Cohen et al.'s (2007) application of the technology on Surrey streets.

TABLE 1: READS, HITS, AND DISPOSITIONS

Description	n (114,847)	%
Read, No Hit	112,422	97.9%
Read, Hit, Disposition	1,534	1.3%
Read, Hit, No Disposition (Operator Error)	236	0.2%
Misread	406	0.4%
Repeat Hit	243	0.2%
Operator Error	6	0.0

The numbers of reads and hits in each of Surrey's seven community areas is presented in Figures 1 and 2.[4] Not surprisingly, there was substantial variation in the number of reads across the

[4] Geographic identifiers (in the form of X and Y coordinates) were available for only 60,223 reads (52.7% of total reads). It is unclear to the authors of this report why only approximately half of the reads had GPS attached.

communities. Guildford, Cloverdale, and Newton had the highest number of reads, while City Centre and South Surrey had the lowest.

FIGURE 1: READS BY COMMUNITY

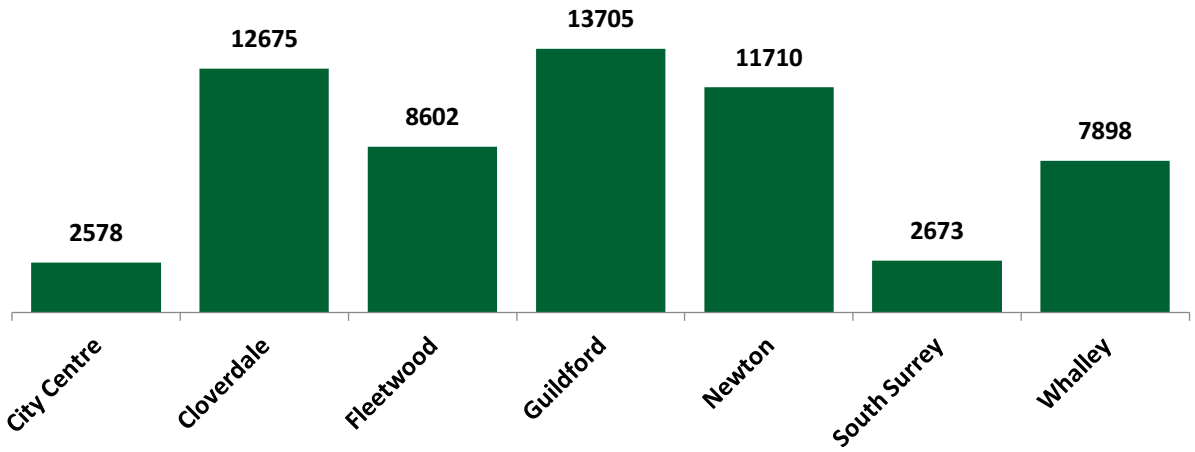
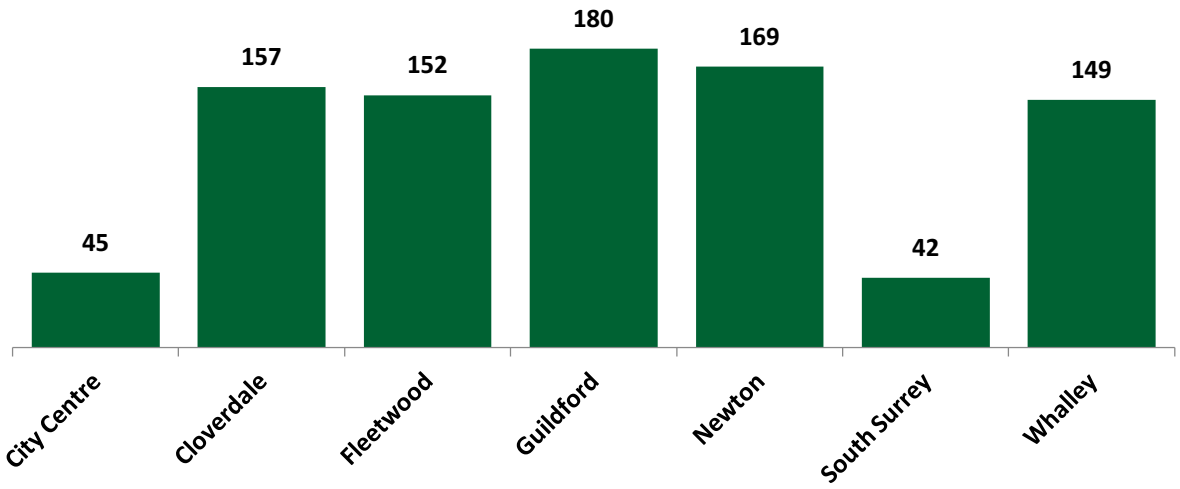
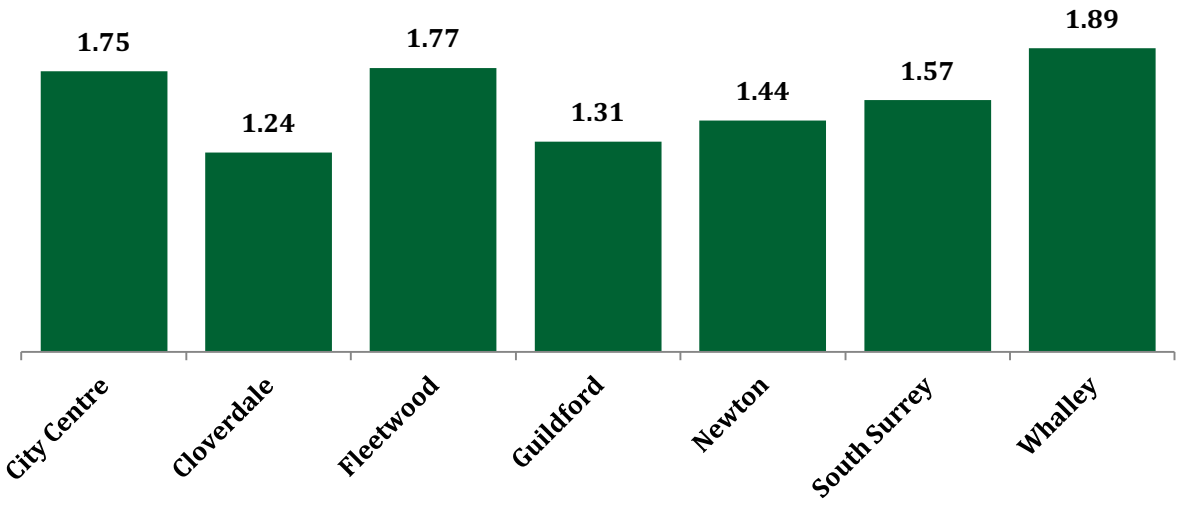


FIGURE 2: HITS BY COMMUNITY



The hit rates for Surrey communities are presented in Figure 3. The pattern exhibited for hit rates stands in direct contrast to those of reads and hits. Apart from South Surrey, the communities with the smallest numbers of reads, City Centre, Whalley, and Fleetwood, produced the highest hit rates. In fact, the differences in hit rates between Whalley (1.89) and both Cloverdale (1.24) and Guildford (1.31) were statistically significant, as was the distinction between Fleetwood (1.77) and Cloverdale. This generally inverse relationship between number of reads and hit rate was a consistent feature of the ALPR data and not unexpected as crime rate and calls for service data would suggest that more offenders would be found in the communities of Whalley and City Centre.

FIGURE 1: HIT RATES BY COMMUNITY



READS, HITS, AND HIT RATES – TIME OF DAY

Not surprisingly, the number of reads and hits varied over the course of day. Figures 4 and 5 demonstrate that the bulk of reads and hits took places between 1100 and 1700 hours, and that ALPR was used very sparingly between 0100 and 0600. It is possible that these findings are reflective of the volume of vehicles on the road at certain times of the day.

FIGURE 2: READS BY TIME OF DAY

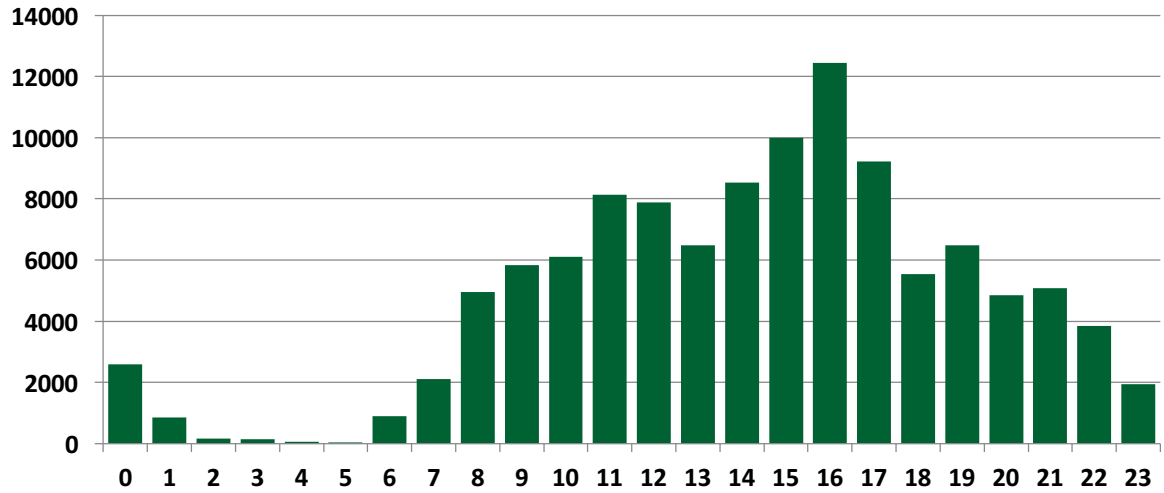
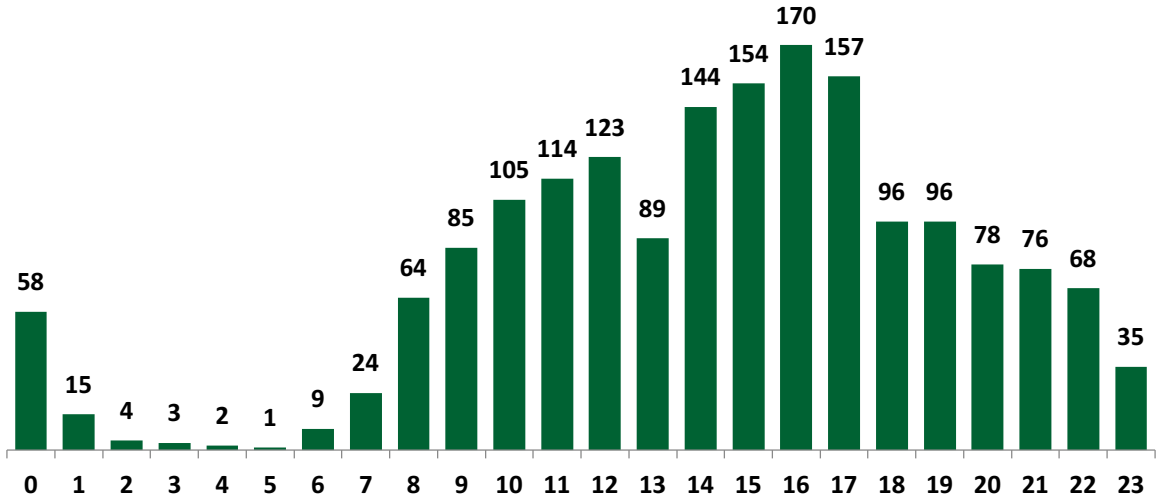
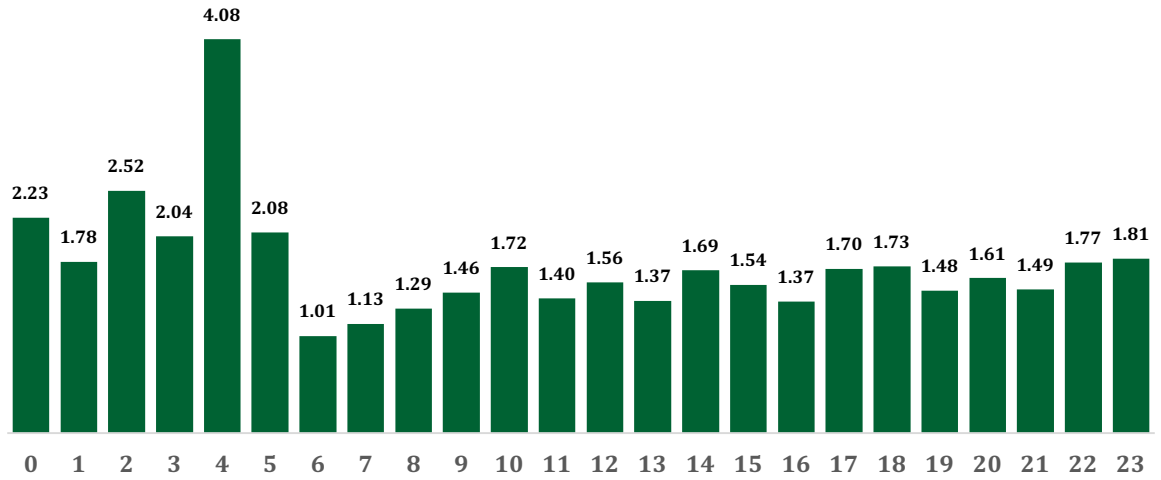


FIGURE 5: HITS BY TIME OF DAY



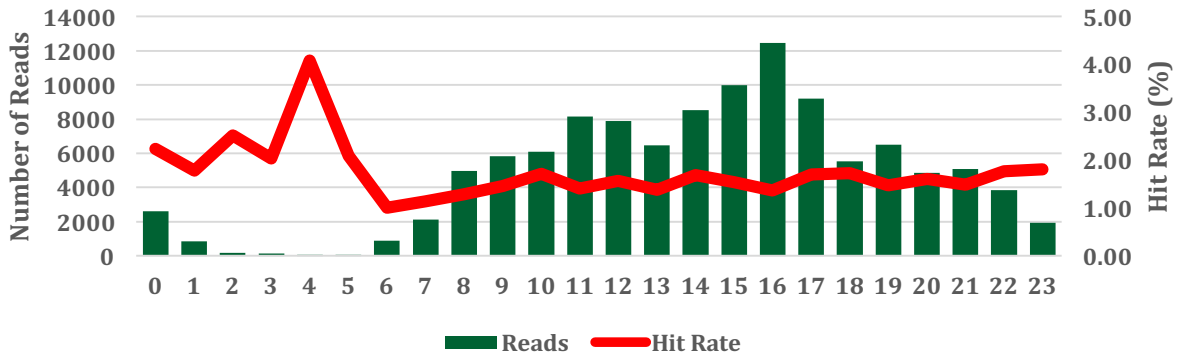
Overall, hit rates by time of day are highlighted in Figure 6. The hit rates were much higher in the late night/early morning hours. In part, this disparity was related to the comparatively smaller number of reads that were attempted during these times. The figures recorded in Appendix A suggest that, in contrast to other times of the day, when ALPR reads were random, ALPR usage between 0200 and 0500 was essentially targeted. That is, it is likely that officers had specific reasons to be in certain parts of the city to read license plates. To the extent that reads were more targeted, higher hit rates would be expected. Nonetheless, the probability of getting a hit was noticeably higher during the late night/early morning hours, but was otherwise fairly consistent throughout the remainder of the day.

FIGURE 6: HIT RATES BY TIME OF DAY



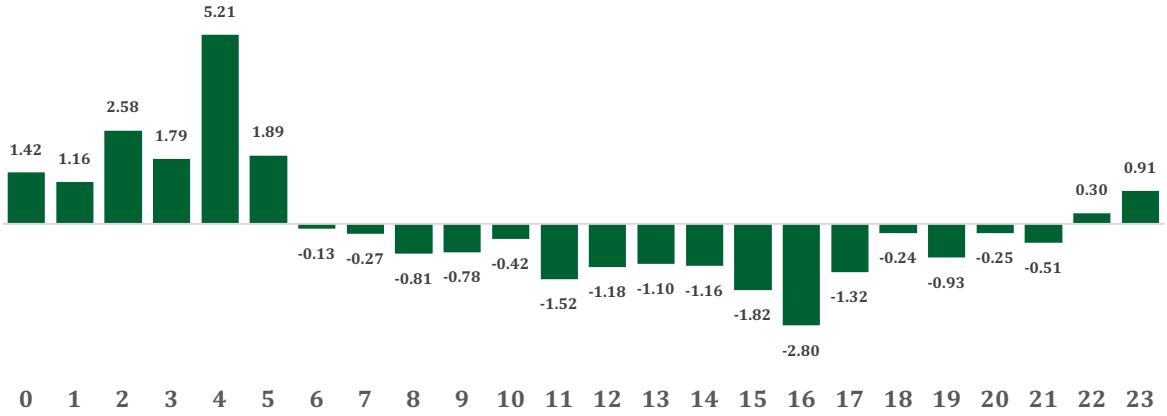
Taken together, Figures 4 and 6 present a paradox. As illustrated in Figure 7, although the number of reads was highest in the afternoon, hit rates were greatest in the early morning. In fact, the correlation between the number of reads and hit rates was actually negative. That is, as the number of reads increased, hit rates tended to fall. This is suggestive of an imbalance in the allocation of resources.

FIGURE 7: READS AND HIT RATES BY TIME OF DAY



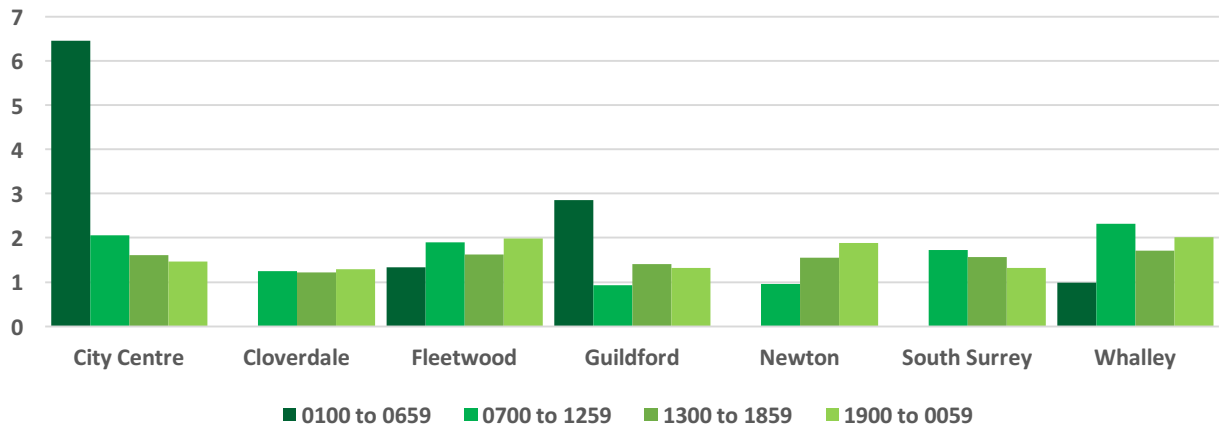
The potential imbalance in ALPR assignment is further explored in Figure 8. In this Figure, reads and hit rates have been standardized (turned into z-scores for purposes of comparison). The bars represent the ratio of standardized hit rates to standardized reads. This line might best be thought of as a measure of efficiency, or "bang for your buck." Positive numbers indicate that hit rates were high in relation to reads, while negative numbers indicate that hit rates were low relative to reads. For example, at 0400 hours, the number of reads was quite low. However, this small number of reads produced a comparatively high hit rate. Conversely, while the largest number rates occurred at 1600 hours, these reads produced a proportionately smaller rate of hits. It is important to reiterate that some of the high hit rates were artificially inflated because of small denominators. Still, reducing hourly variations in hit rates may produce useful gains in efficiency.

FIGURE 8: STANDARDIZED DIFFERENTIALS - READS VS. HIT RATES BY TIME OF DAY



The time of day analysis is extended to communities in Figure 9. To facilitate comparison, time has been aggregated into six hour segments. It appears that the elevated hit rates exhibited between 0100 and 0600 hours were primarily driven by City Centre and Guildford. Outside of these spikes, hit rates were quite stable and did not differ substantially within communities across time periods. This relative stability further cautions against overstating the significance of differences throughout the day.

FIGURE 9: HIT RATES BY TIME OF DAY AND COMMUNITY



READS, HITS, AND HIT RATES – DAY OF THE WEEK

Figures 10 and 11 present the numbers of reads and hits across the days of the week. The level of ALPR activity was considerably lower in the early part of the week (Monday through Wednesday) and higher later in the week and on Sunday.

FIGURE 10: READS BY DAY OF THE WEEK

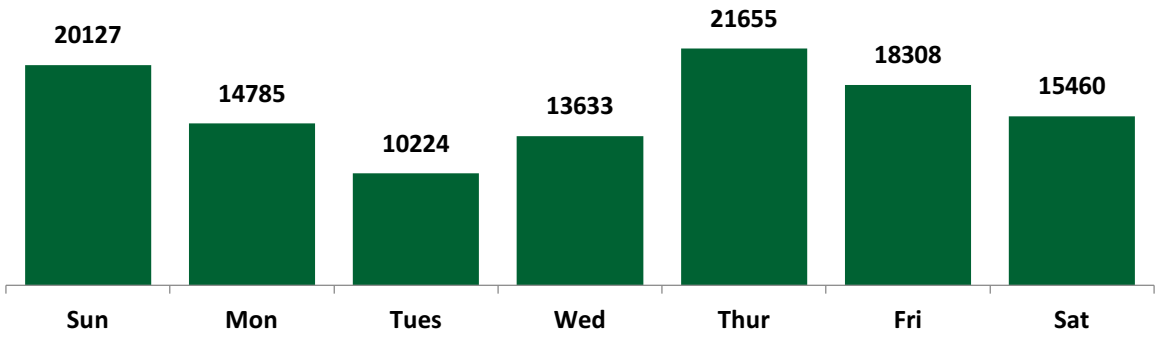
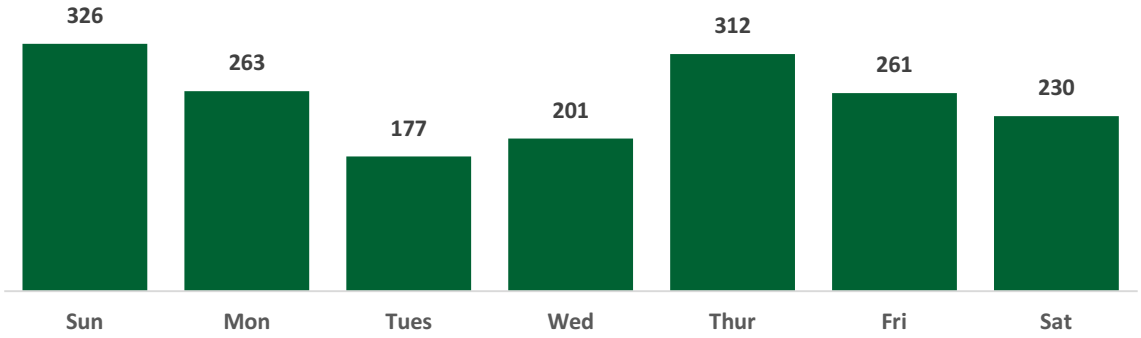


FIGURE 11: HITS BY DAY OF THE WEEK



As demonstrated in Figure 12, hit rates were fairly constant throughout the course of the week. But, reminiscent of the time of day analysis, hit rates were highest on the days with the lowest number of reads, particularly Monday and Tuesday. This pattern is made clear in Figure 13.

FIGURE 12: HIT RATES BY DAY OF WEEK

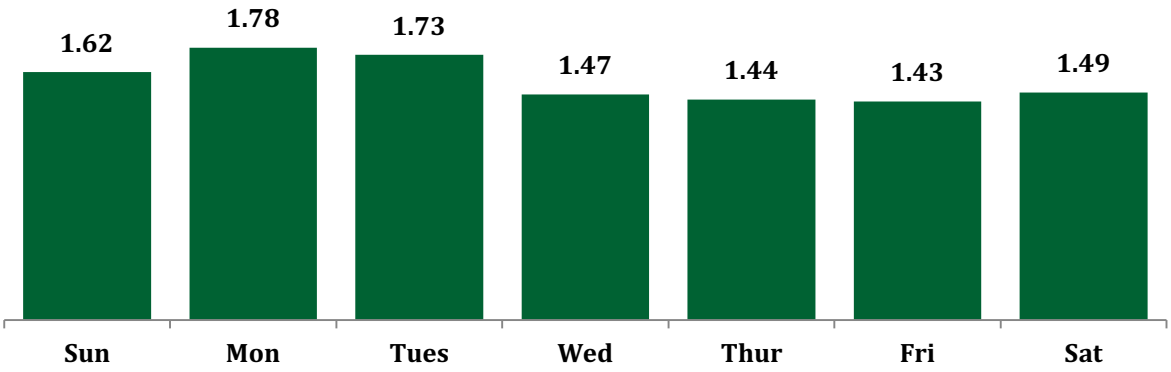
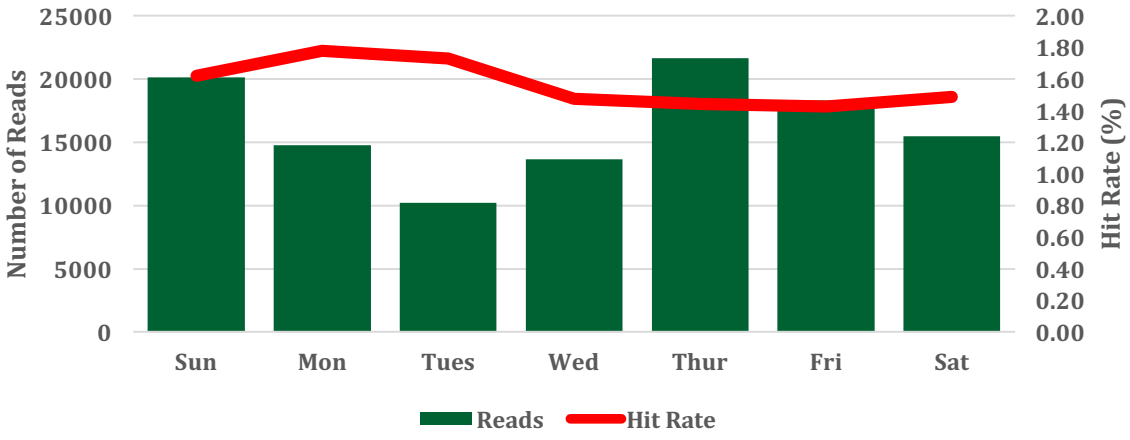
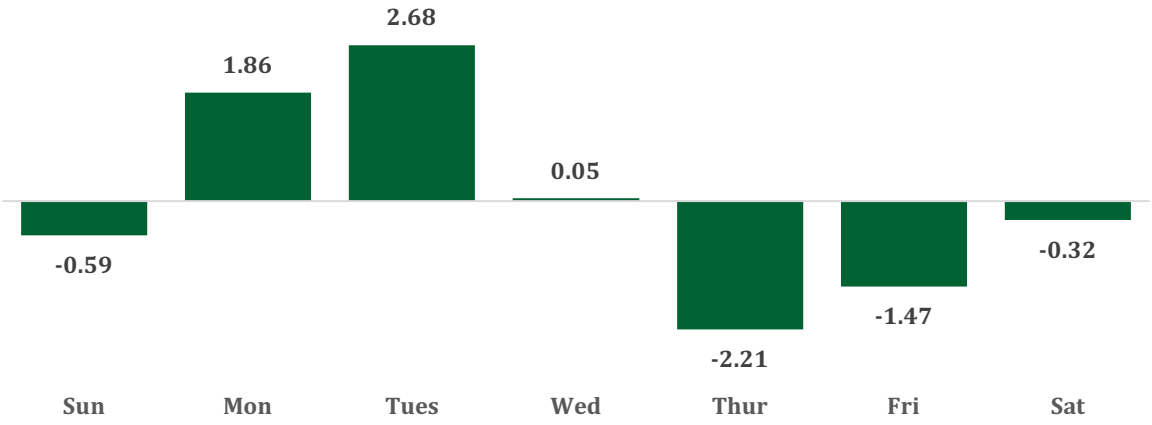


FIGURE 13: READS AND HIT RATES BY DAY OF WEEK



Again, the gap between reads and hit rates when the data is standardized raises the issue of efficiency. The results illustrated in Figure 14 argue for a more balanced approach to ALPR deployment across the week. It is possible that hit rates may be increased simply by increasing ALPR use early in the week, especially on Tuesday, and decreasing ALPR use later in the week, most notably on Thursday.

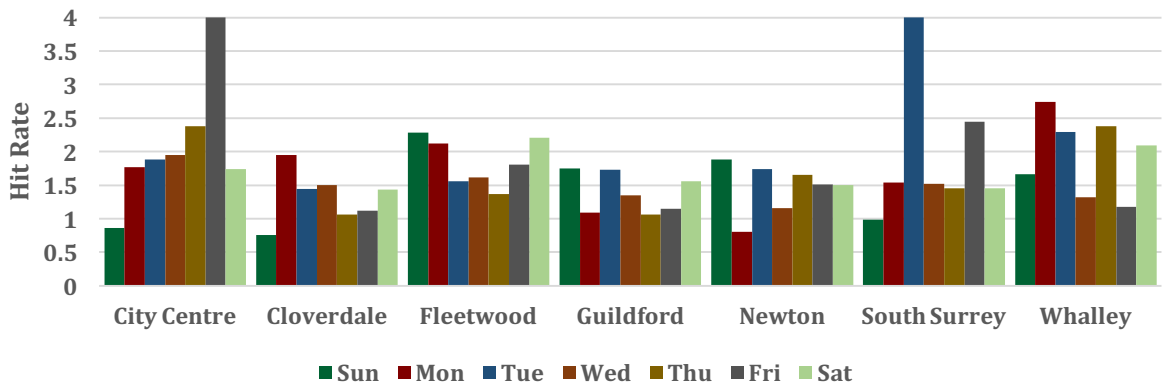
FIGURE 14: STANDARDIZED DIFFERENTIALS - READS VS. HIT RATES BY DAY OF WEEK



There is considerable evidence of more or less random hit rate fluctuation for Surrey communities across the days of the week (see Figure 15).[5] Both of the spikes were statistical artifacts produced by sample sizes. For example, the hit rate of 4.00 for City Centre on Mondays was based on only 50 reads. Similarly, the hit rate of 33.33 for South Surrey was based on only three reads. More interesting than the spikes themselves is what they represent, namely ALPR deployment anomalies.

[5] The Tuesday value for South Surrey has been truncated. The actual hit rate was 33.33, but it is based on a very small sample.

FIGURE 15: HIT RATES BY DAY OF WEEK AND COMMUNITY



READS, HITS, AND HIT RATES – MONTH

The distribution of ALPR reads and hits by month exhibits patterns similar to the previous analyses. ALPR was used most extensively in the summer months and was much more limited in the winter (Figures 16 and 17). Similar to the above findings, the relationship between reads and hit rates tended to be inverted; the highest hit rates occurred in October and November, both of which recorded comparatively smaller numbers of reads. In comparison, widespread ALPR deployment in the summer produced proportionately fewer hits (See Figures 18 and 19). This imbalance is reflected in the standardized differentials highlighted in Figure 20.

FIGURE 16: READS BY MONTH

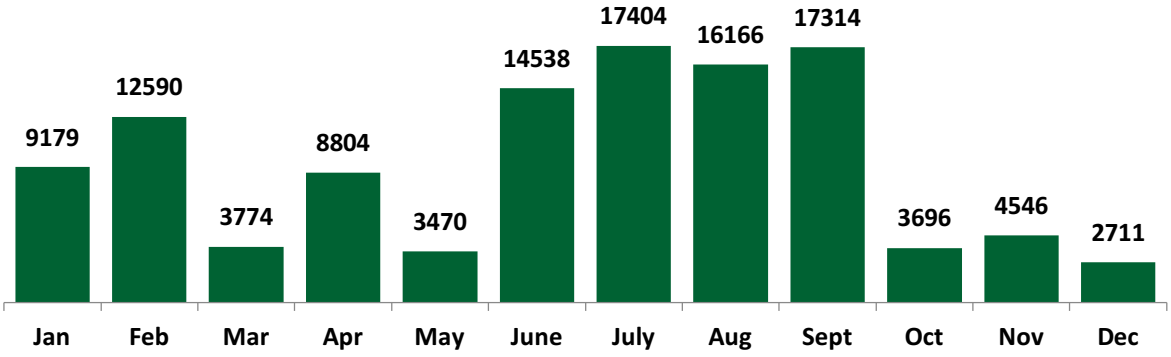


FIGURE 17: HITS BY MONTH

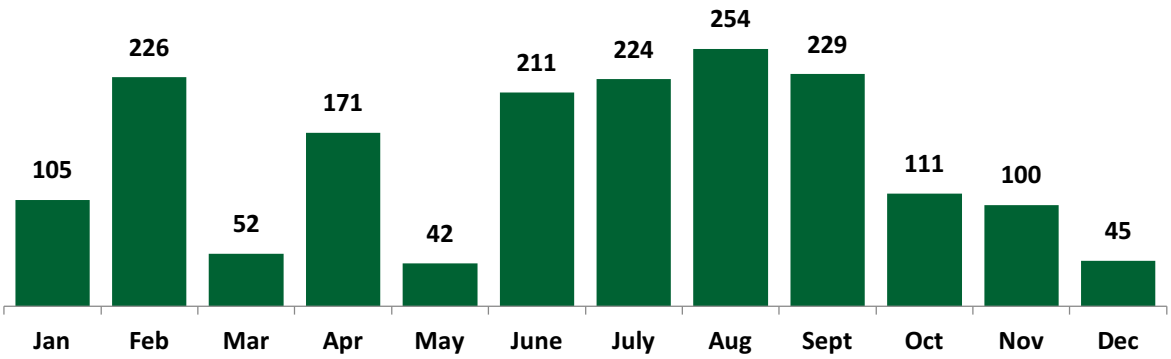


FIGURE 18: HIT RATES BY MONTH

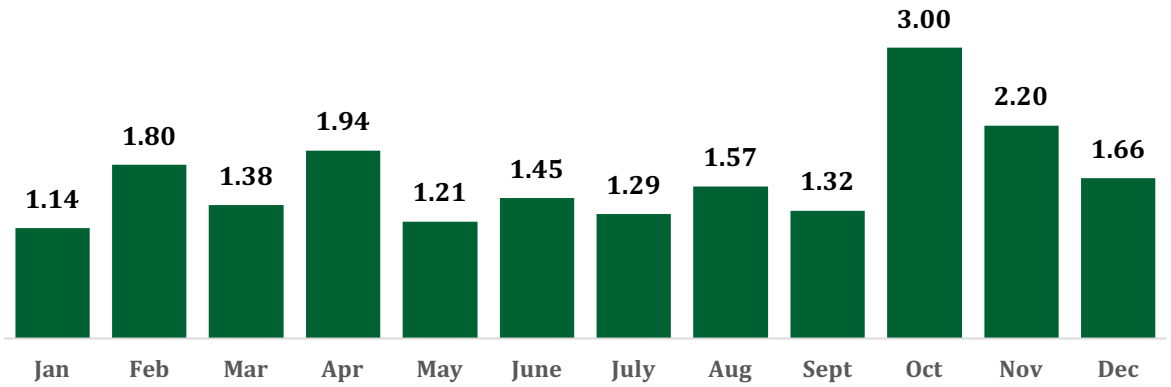


FIGURE 19: READS AND HIT RATES BY MONTH

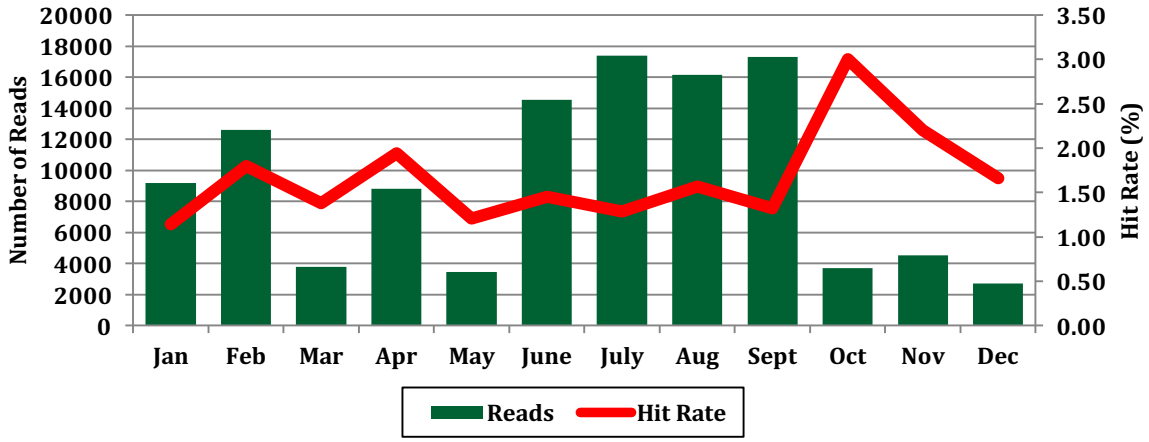
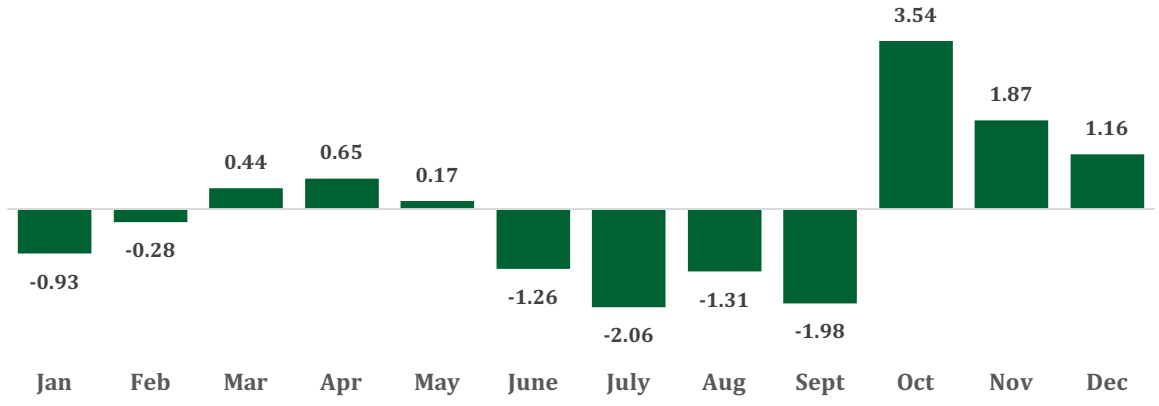
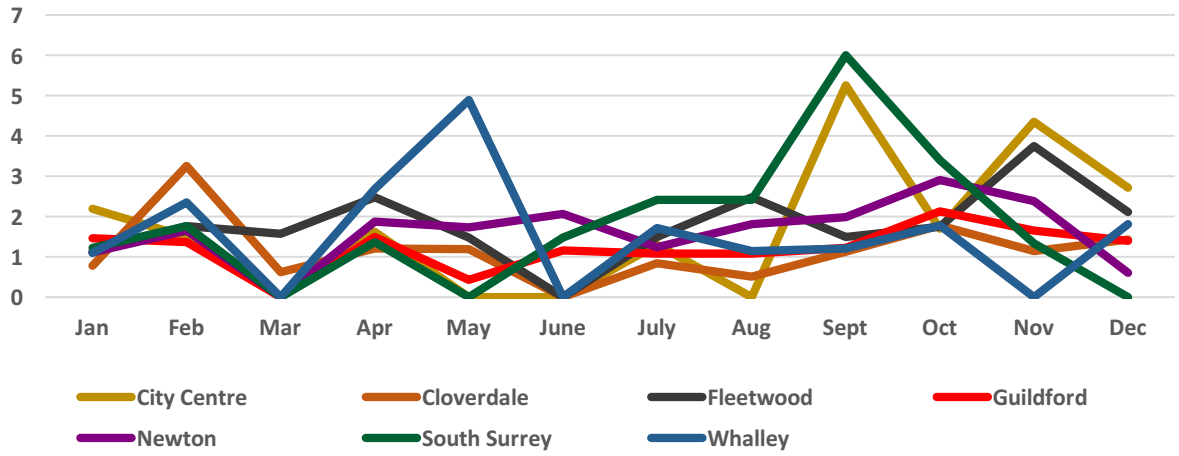


FIGURE 20: STANDARDIZED DIFFERENTIALS - READS VS. HIT RATES BY MONTH



The community-level analysis of monthly hit rates is presented in Figure 21.[6] Again, there are differences in ALPR deployment within communities, but these differences do not appear to have been systematic.

FIGURE 21: HIT RATES BY MONTH BY COMMUNITY



HOT LIST HITS

As noted above, 1,770 reads produced hits. In some cases, more than one type of hit was returned for a single read. Thus, the 1,770 read events actually resulted in 1,826 hot list hits. The distribution of the five possible types of hot list hits is presented in Table 2. More than half of all hits (54%) were in relation to an Unlicensed Driver. This figure is significantly lower than the 70% for

[6] The September value for South Surrey has been truncated. The actual hit rate is 25.00, but it is based on a very small sample.

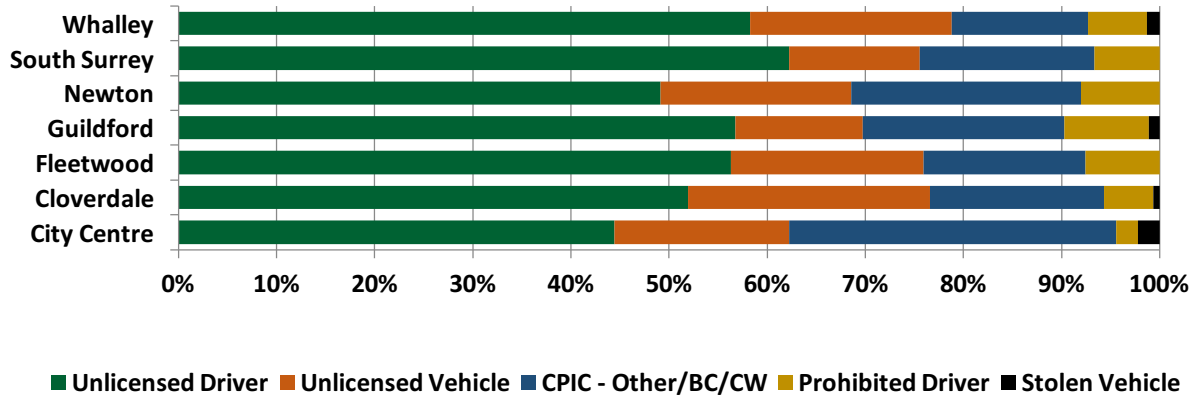
Unlicensed Driver hits in the study by Cohen et al., 2007. This discrepancy can be attributed to the number of "CPIC Other" hits. This category, which was not included in the pilot study, accounted for 20% of hits. The proportions of hits corresponding to the other three hot list categories were roughly the same as they were for the pilot study. Approximately 20% of hits pertained to Uninsured or Unlicensed Vehicle, while another 5% were in relation to Prohibited Drivers. Lost Vehicles, a category that also includes lost or stolen license plates, generated less than 1% of hits.

TABLE 2: HOT LIST HIT CATEGORIES

Category	%
Unlicensed Driver	54.6%
CPIC - Other	20.1%
Uninsured/Unlicensed Vehicle	19.3%
Prohibited Driver	5.3%
Stolen Vehicle/Lost or Stolen License Plate	0.8%

Figure 22 shows that the pattern of hot list hits is reproduced in each of the communities. With the exception of City Centre, Unlicensed Driver was by far the most common type of hot list hit in each community. The proportion of hits related to Uninsured/Unlicensed Vehicle and CPIC Other was generally equal in each community.

FIGURE 22: HOT LIST HIT CATEGORIES BY COMMUNITY



DISPOSITIONS

"Disposition" refers to the action taken by the officer following a hit. The full range of dispositions is provided in Appendix D, while a summary of the most salient categories is presented in Table 3. In over a majority of the cases involving hits (57%), the vehicle that generated the hit was Not Stopped. There are numerous reasons for why a "hit" vehicle might not be stopped, such as the member might not have been able to stop the vehicle safely, a member may have received multiple hits at the same time and selected one vehicle to stop allowing the others to continue, a member dealing with one situation may not have turned off the ALPR resulting in several hits while the member was attending to a previous stop, or the hit was from the CPIC – Other category in which the member may not have been able to take action against the driver.

In another 12% of cases, hits were generated by vehicles that were parked and unoccupied. If the cars were stolen, members may have set up surveillance on the car in the hopes that the offender returned, or the member might have had the vehicle towed. But, if the vehicle was not stolen, the hit produced no further action by the member. About the same proportion of cases (13%) resulted in No Charge Action. As shown in Appendix D, No Charge Action most often referred to situations in which the registered owner of the vehicle was not driving the vehicle or where the driver possessed a valid driver's license. Finally, in an additional 14% of instances, the disposition data was missing.

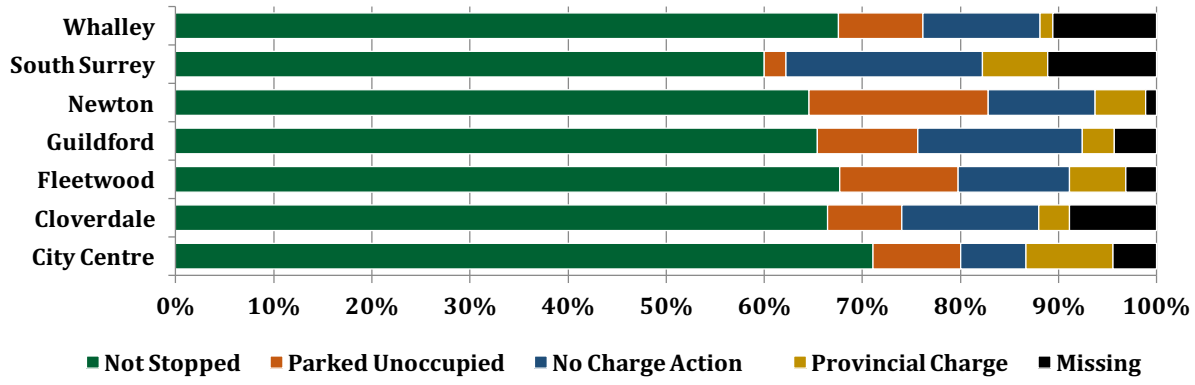
Taken together, the data indicated that "active" dispositions in the form of a provincial (or Criminal Code) charge occurred in less than 5% of hits. Consistent with the most common source of the hit, the most prevalent provincial charge was for not having a driver's license (see Appendix D). Other provincial charges included having no insurance, driving while prohibited or contrary to restrictions, or driving without an 'L' or 'N'.

TABLE 3: DISTRIBUTION OF DISPOSITIONS

Description	%
Not Stopped	56.6%
Missing Data	13.7%
No Charge Action	12.8%
Parked Unoccupied	12.2%
Provincial Charge	4.7%

The aggregate pattern of dispositions was mirrored at the community level. However, as demonstrated in Figure 23, the problem of "missing" dispositions was more pronounced in some communities than others. Cloverdale and Whalley, in particular, generated a considerable portion of such cases.

FIGURE 23: DISPOSITIONS BY COMMUNITY



The relationship between hot list hits and their corresponding dispositions is presented in Table 4. With the exception of Stolen Vehicles, the Not Stopped disposition was utilized most often. Not Stopped was the outcome in approximately two-thirds (67%) of CPIC Other cases. This was to be

expected, as many of these types of hits were not things that members could deal with, such as the car being registered to a known gang member. Conversely, only three Stolen Vehicle hits did not result in a stop. More troubling is the fact that the outcome of the other 11 Stolen Vehicle hits was not specified. Missing dispositions were also acute in the context of Uninsured/Unlicensed Vehicles.

In terms of the other possible dispositions, Unlicensed Vehicles were found to be Parked Unoccupied slightly more than 20% of the time, while roughly the same proportion of Prohibited Driver hits resulted in No Charge Action. Provincial Charges occurred at essentially the same rate for Unlicensed or Prohibited Drivers and Unlicensed Vehicles. CPIC Other hits generated very few provincial charges, while Stolen Vehicle hits generated none.

TABLE 4: HOT LIST HITS AND CORRESPONDING DISPOSITIONS

	Unlicensed Driver (n = 974)	Unlicensed Vehicle (n = 348)	Prohibited Driver (n = 131)	Stolen Vehicle (n = 14)	CPIC – Other (n = 359)	Total (n = 1,826)
Not Stopped	57.6%	44.8%	55.0%	21.4%	67.4%	56.6%
Parked Unoccupied	9.4%	21.6%	9.9%	0	12.0%	12.2%
No Charge Action	15.9%	9.2%	22.9%	0	4.7%	12.8%
Provincial Charge	5.6%	4.6%	6.1%	0	1.4%	4.6%
Missing	11.4%	19.8%	6.1%	78.6%	14.5%	13.7%

Findings from the Interviews with Surrey RCMP ALPR Users

In Surrey, the hot list is generated once per day through an information transfer to the various RCMP detachments across the province. The hot list is transferred around 4am each morning and is uploaded to the vehicle when the member assigned to use ALPR comes on shift. As mentioned above, the hot list is generated from the Insurance Corporation of British Columbia (ICBC) and the Canadian Police Information Centre (CPIC). ICBC provides information on the vehicle (e.g. expired insurance) and the registered owner (e.g. unlicensed or prohibited), while CPIC data provides license plates of reported stolen vehicles and of vehicles associated to persons with outstanding warrants. Despite Denham's (2012) admonishment of the use of the Other Pointer Vehicle category, this information is still provided in the hot list. These flags appear as "CPIC Other" on the system, and require further investigation prior to being acted upon. Essentially, the ALPR "hot list" is composed of license plates associated to stolen vehicles, stolen license plates, BC Wide and Canada Wide warrants, pointer vehicles (CPIC other category), prohibited drivers, unlicensed drivers, and uninsured drivers (RCMP "E" Division Traffic Services, nd). As noted, this list is updated once every 24 hours; however, RCMP policy permits members to manually update the list should an Amber Alert occur (section 3.1.1.).

There is one marked police vehicle in Surrey equipped with ALPR technology. It has three cameras mounted on top of the vehicle with the computer and batteries stored in the trunk. The database information is transferred between the office workstation and the vehicle using a memory key, a process that happens once at the start of the shift and once at the end of the shift. Typically, members reported that the file transfer process takes several minutes to occur. At the end of the

shift and prior to logging out of the ALPR system, the member spends about 10 to 15 minutes completing a paper log documenting any hits that were generated during the course of their day and the actions taken on those hits; the bulk of this information is also transferred to RCMP E-Division headquarters electronically.[7] The member then completes their paper log and signs out of the vehicle's ALPR system.

When the member is patrolling and operating ALPR, two of the cameras are generally activated. These cameras are both forward facing; one reads the front licence plates of oncoming traffic, while the other reads the rear licence plates of vehicles as they pass by the police vehicle. These two cameras will also scan the plates of vehicles parked on the side of the road. There is also a third camera intended for use in parking lots. Each plate that is scanned by a camera will appear on the ALPR screen on the mobile data terminal in the police vehicle. This screen is split into two sides; the left portrays images from oncoming traffic and the right portrays images from traffic behind the police vehicle. Each scan provides a picture image of the plate and a transcribed version. Most of the time, these images will match up for an accurate read; however, in some situations, a character will be misread (e.g. a 1 for an L, or a P for an R) or the camera will pick up on a reflective image other than a license plate, such as a yield sign on the road or advertising on the side of a vehicle. In these cases, the image is considered a "misread".

The transcribed license plate is automatically compared to the database loaded into the police vehicle and if a match is generated, a "hit" is produced. In this situation, the ALPR system will produce an auditory tone and a colour-coded warning will flash onto the screen indicating the priority level of the hit (low alert for no driver's license, medium alert for prohibited driver, no insurance, or CPIC other, and high alert for stolen). The member operating the vehicle will then compare the transcribed plate to the image to confirm the accuracy of the read and, if a match is confirmed, will consider whether to make a traffic stop. Factors affecting this decision include the priority level of the hit and the member's ability to safely follow and stop the targeted vehicle. For instance, if the vehicle is travelling in the opposite direction in heavy traffic, the member may decide to let the vehicle go as they cannot quickly and safely execute a U-Turn. RCMP policy on ALPR uses states that a member must first confirm the accuracy of the hit with either CPIC or ICBC before acting on it (section 3.2). Of note, section 3.3 states that if the hit is the result of the Other Pointer Vehicles (CPIC) database, the member must identify a valid reason to stop the vehicle. Thus, consistent with Denham's (2012) request, police cannot simply stop a vehicle because the owner is known to have mental health issues or is a registered sex offender. There must be an enforcement related reason to stop the vehicle, such as an expired license plate or an observed road violation.

At the end of the day when filling out the paper log, the license plates of all vehicles that had a correct "hit" is recorded and the disposition (e.g., no action taken, ticket issued, arrest made) is noted. Each plate that is read by the cameras and results in a hit generates an information file, including the picture image of the plate, the transcribed plate, the GPS location of the vehicle, the date and time of the read, and the nature of the hit. This information is all transferred to RCMP E-

[7] Of note, the paper log requirement was phased out across the province in January 2014. It is not clear why at the time of these interviews (March 2014) members were continuing to complete the paper log in Surrey.

division headquarters at the end of the shift. The ALPR Terms and Conditions for Participation prepared by "E" Division states that "ALPR images and data related to non hits are not retained" (RCMP "E" Division Traffic Services, nd: Point 6) with the exception of very basic information that simply provides that a plate was read, but which is not associated with any specific plate information or image. In contrast, as the hit data is a record, it is kept for two years as it could result in legal action (RCMP "E" Division Traffic Services, nd). The information sent to E-Division Traffic Services from across the province is then used to generate quarterly reports, such as the number and nature of hits; however, it does not appear that this information is sent to the members.

TRAINING

A member from RCMP E-Division Headquarters, who took members through the operational aspects of the software, the policy restrictions, and the application of the technology, provided the ALPR training. Training lasted approximately half a day and consisted of a mix of classroom learning and live demonstrations. Members reported only being trained once on the software, but felt that this was sufficient, so long as they were regularly involved in ALPR deployment. Given that some of those trained on ALPR have either not used their training or were using it very infrequently, that members rarely paid attention to notices of software upgrades, and that there may be policy changes from time to time affecting their use of ALPR, a shorter refresher course may be of use. This would also allow users of the technology to both share effective deployment strategies and success stories with each other, as well as discuss with RCMP E-Division Headquarters possible improvements to the software and the technology to make their use of ALPR more effective and efficient.

Of note, one participant suggested that approximately 20 members from the Surrey RCMP detachment had received training on ALPR at one point or another. However, many of these members have transferred to different units. This has reduced the numbers of ALPR trained traffic duty members to approximately five or six; however, at least one of these individuals is in a more senior management position and not directly using their training. Further to this, not all of those trained in ALPR and on active road duty are using their training. Specifically, the reporting requirements associated with the application of the technology (e.g. the paper log) seemed to deter some of those who could be using ALPR from actively requesting to use the ALPR-equipped vehicle.

FREQUENCY OF USE

As the Surrey RCMP operate on a 12-hour shift schedule varying between four watches, technically the one police vehicle with ALPR technology could be assigned for use 24 hours per day, 7 days per week across four different members, each from a different watch/traffic team. However, to avoid potential conflicts with the vehicle not being available, such as when one member's shift runs late, the vehicle is only assigned to two members on opposite watches/traffic teams. While this means ALPR *should* be in use for up to 12 hours per day, currently it is only being used four days per week, given the long-term leave of one of the two assigned members. Of note, although other members of the unit have had training in ALPR, it appears to be relatively rare for one of them to take the vehicle out during their shift given that it was not their assigned car and there was an implicit

dislike of "taking another guy's car". Therefore, it appears that, for at least the recent past, ALPR has not been used on a frequent or consistent basis in Surrey. Beyond the recent past, although it was used more regularly, there were still significant periods of the day (12 hours or more) during which the ALPR technology was sitting idle as it is only assigned to two watches/traffic teams.

Even when a member assigned to the ALPR vehicle was on shift, they were not necessarily using the technology for each of their four days of patrol. To use the technology in any given shift, the member must log onto the office workstation at the start of their shift to download the hot list database before transferring it via USB key to the vehicle for upload. However, it appears that access to this one workstation is not always available, resulting in members, at times, taking the car out and leaving ALPR off for their shift.[8] As it appears relatively infrequent for traffic members to return to the office during the day, the failure to download and transfer that day's database means that the technology will go unused for the entire 12 hour shift. In effect, ALPR appears to be infrequently used in Surrey for three main reasons; 1) it is only available on a single police vehicle, 2) there are only two assigned members to the ALPR vehicle, and 3) other ALPR-trained members are deterred or choose to not use the ALPR-enabled vehicle.

SOFTWARE UPGRADES

Members noted that the ALPR software would be periodically updated; however, their attention to this could be improved. Specifically, while they acknowledged that they likely received information about the nature of software upgrades, they paid little attention to these briefs. Instead, they simply noticed the software change once they turned the system on. That said, one recent software upgrade they specifically recalled was the change in searching for disposition options when the technology indicates a "hit". In the past, members had to toggle through a lengthy list of available dispositions to find the correct category, a process that they reported could take several minutes to complete. A recent software upgrade categorized these selections into a dropdown list that members could more quickly move through, an upgrade that they were very pleased with. That said, members had several recommendations for other improvements that could be made to the technology.

One deterrent to the more frequent use of ALPR is the knowledge that it will bring additional paperwork at the end of the shift. There is a requirement from E-Division RCMP Headquarters that each detachment complete a paper log indicating the number of hits and the associated action or inaction.[9] This information is faxed to headquarters at the end of the shift. However, it appears that the bulk of this information is already transferred to headquarters electronically and that the paper log is essentially a duplicate for the vast majority of the information, with one notable exception; the assigned file number. A simple software upgrade to allow for the member to assign a file

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[8] Of note, the ALPR program can be loaded at no charge from E Division onto any number of office workstations in the detachment.

[9] As indicated above, the requirement to complete a paper log was phased out across the province in January 2014.

number to any "hit" plate would remove this redundancy and possibly encourage greater utility of the technology.

Another recommended software upgrade was to extend the list of dispositions currently available. Currently, there is a set selection of options to choose from when a plate has been "hit", such as driving without a license or without insurance. However, the members noted that speeding was not an option. Although ALPR is not used for speeding enforcement in the city of Surrey, it may be a supplementary reason for why the member stops a vehicle. For instance, in the case of a CPIC Other hit, the member must be able to articulate another reason for why they stopped the vehicle, such as speeding or suspected driving while under the influence. Thus, they would like additional categories to reflect this justification, even if it is not directly associated with the nature of the hit.

Traffic members would also appreciate the ability to pause the camera so that they can keep the program running in the background when responding to a call for service. Currently, if the member responds to another incident, such as a traffic collision, they will frequently close the database down entirely as leaving it running in the background means that if it scans and hits on a plate while the member is responding to the more urgent call, the information about the hit will pop up on the screen and displace the information about the more urgent call. Although this practice will not completely log the member out of the program, it creates unnecessary steps and poses potential threats to their safety, as they will need to manually navigate the computer back to the information about the priority call, typically while still driving their vehicle.

DEPLOYMENT

Members were asked about the decision-making processes behind how ALPR technology is deployed on a typical shift. It seems that there is a lack of informed use of this particular technology, as generally it is being used as a silent partner running in the background while the member goes about their daily traffic enforcement, as opposed to a proactive deployment. It appears that the technology is primarily used in areas of the city with perceived high levels of traffic volume and where historically there have been more violators detected, such as Whalley and Newton. In two separate interviews, it was noted that ALPR technology was rarely deployed to the historically quieter zones of South Surrey and Cloverdale.[10] The reasons provided by members for this practice was that the daily decisions about traffic enforcement appeared to be based on traffic-related calls for service (e.g., crash data), meaning less deployment in certain zones of the city. It was acknowledged during one interview that, ideally, ALPR vehicles would be routinely deployed in areas known for high collisions and high crime rates as these were areas where known traffic violators and more prolific offenders are likely to be. However, while there is a benefit to conducting directed proactive patrols based on crime analysis, such as the Data Driven Approach to Crime and Traffic Safety (DDACTS) model, currently, this is not the way ALPR is deployed in Surrey. This is unfortunate given the findings of prior research that has consistently demonstrated

[10] This statement was at odds with the data study that found that Cloverdale had the second highest level of reads. This discrepancy may be the result of missing data, as almost half of all reads did not have geographic identifiers.

increased effectiveness in detecting stolen vehicles and other forms of traffic violations when ALPR is deployed strategically.

Despite the current lack of strategic employment in Surrey, ALPR has previously been strategically deployed from time to time elsewhere in British Columbia. One study participant recalled that while working elsewhere with the RCMP, they successfully ran traffic blitzes using ALPR in partnership with the Integrated Road Safety Unit (IRSU) who had an unmarked ALPR equipped-vehicle. They strategically deployed their strike team in a high-volume area of the city with the unmarked ALPR-equipped vehicle located at an entrance ramp to a highway and another five police cars located at the exit of the ramp. The ALPR vehicle scanned the plates of vehicles heading towards the highway and, if a hit resulted, the police vehicles further down the ramp would be notified to pull over the approaching vehicle. This practice generated a substantial number of hits and was considered a successful strategy for removing traffic violators from the roadway. However, although they would like to see similar strategies implemented in Surrey, the participant acknowledged that Surrey traffic services alone does not have the manpower required to fully execute such a strategy, as at least five different police vehicles, in addition to the ALPR-equipped vehicle, would be needed to make the effort worthwhile. While additional resources are being added to traffic services, at the time of these interviews, traffic services ran only a three-vehicle team at any given time.

Thus, in its current deployment, ALPR technology appears to simply be one tool among others used by some traffic members during their standard patrol activities. For instance, the member will leave ALPR running in the background, along with their radar and laser technologies, while they are patrolling the streets in their marked police vehicle. At other times, ALPR will be used more intentionally, such as when a member parks the police vehicle in the median of a busy road and uses ALPR to scan vehicles approaching from both directions, or when they take the vehicle at night to quieter streets that may be used by impaired drivers. However, the decision about where to take the vehicle on any given day appears to be based more on instinct and familiar practice than it is informed by recent traffic and crime statistics and analyses.

As mentioned above, the ALPR vehicle in Surrey is equipped with three cameras; two facing forward and one for stationary vehicles. However, it appears that traffic members do not use the stationary or parking camera. There were two main reasons identified for this. First, given that the vehicle is parked without an occupant, should the read result in a "hit", the member would need to wait in the lot until the driver returned to the vehicle before possibly taking action. This is obviously not a good use of the member's time. Further, in some instances, the person driving the vehicle is not the person who generated the hit and the member would have waited in vain. Second, while parking lots may be a good location to scan and detect stolen vehicles, given that the hot lists are generated with historical rather than active data, it is unlikely that recently stolen vehicles would be readily detected this way.

Members were also asked about the physical location of the cameras on the vehicles and whether they would recommend that the cameras be movable. Unanimously, members agreed that the cameras should not be movable as, given the delicate nature of the equipment, this would likely result in a lot of broken cameras. Further, they suggested that if the cameras were not in an optimal position to read a plate, it would be easier to reposition the vehicle than to physically shift the angle

of the camera. In effect, the physical deployment of the cameras appears to be to the members' satisfaction, with one exception. There is only one ALPR system in Surrey and it is located on a marked police vehicle. As will be discussed below, the fact that the technology was on a marked vehicle led participants to perceive that ALPR was not as effective as it could be in detecting certain types of vehicles (stolen) and drivers (prohibited) of interest. Surrey may want to consider using ALPR with unmarked or covert police vehicles, depending on their primary purpose in deploying the technology.

CURRENCY OF INFORMATION

As previously noted, the ALPR database is uploaded once per day by members from the office workstation onto the vehicle database. Likewise, the information for this database is transferred once per day by ICBC at approximately 4 to 5 am and is downloaded by the member once they come on shift, whether that be at 6am or 6pm. While the lack of currency of information would seemingly be problematic, particularly for night shifts, members were in agreement that the system worked well for their needs and that they were not interested in having real-time data. In fact, they perceived that real-time data would result in a much slower system, given the technological requirements of having a direct and ongoing feed to the source of the information. Members were asked whether having information transferred twice per day (e.g. 4am and 4pm) might be useful, but they preferred the current system, as they perceived that there would not be that much change occurring over the course of the day. Although real-time data would increase the chances of detecting stolen vehicles, the fact that ALPR is currently only available in one vehicle that is on the road for only part of the week suggests that this solution alone will not significantly enhance the capacity of ALPR to detect stolen vehicles in Surrey. However, while members were satisfied with the currency of the information available to them, other information deficiencies were noted; these are discussed in the Information Deficiencies section below. It should also be noted that the members were satisfied with the length of time hit data was retained (two years) as this was sufficient for their investigative purposes. However, outside of this unit, if ALPR data was to be used for investigatory purposes, such as to further a homicide investigation, the non-hit data would need to be retained for a pre-determined period of time.

BENEFITS OF USING ALPR

Members were unanimous about the main benefit of ALPR technology – it allowed them to run far more plates than they could ever hope to do manually. Over a 12-hour shift, one member estimated he could manually run at most 300 plates. In contrast, ALPR could run over 2,000 plates depending on traffic volume. During the approximately half an hour ride along that was conducted prior to the interviews, the vehicle was driven to a busy stretch of road where it was parked in the median. During the drive to and from the station, along with the time spent parked in the median, the system scanned 223 plates. Over a 12 hour period of consistent volume, the system could potentially scan more than 5,000 plates.

The members perceived that ALPR was most efficient in high traffic volume segments of the city, particularly when they could park the vehicle in such a way as to catch multiple lanes of oncoming

and passing traffic. One member estimated that running 2,000 scans in one day could generate between 30 and 40 hits, depending on what part of the city was being patrolled. The technology was especially appreciated at night or during poor weather conditions when ALPR could read plates much more accurately than the member could manually. In fact, the only situations where members complained about the ability of the cameras to read plates were in heavy rain or fog situations. In other words, they reported that the cameras worked well in virtually all typical weather conditions experienced in Surrey and worked equally well in the daytime as at night. In addition, the technology is able to read through plastic covers used by some drivers to circumvent bridge tolls. There were only two situations in which ALPR could not effectively read a plate; when the plate was caked with mud or when a trailer hitch was positioned so that it effectively blocked the license plate. However, as both these situations are technically illegal, the member can execute a traffic stop even without ALPR generating a hit. Further, the member is actually more likely to generate a traffic stop in these types of situations, as they are often a purposeful means of circumventing toll cameras and ALPR.

Participants emphasized that ALPR allowed them to detect traffic violations that they would not normally be checking for, such as whether the car was currently insured. Essentially, members described ALPR as a "silent partner". It ran in the background looking for unlicensed drivers, uninsured vehicles, prohibited drivers, and stolen vehicles while the member was focused on identifying other traffic violations, such as failing to use a seatbelt or forms of distracted driving. In other words, ALPR looked at the plate while the member looked at the driver. In this way, ALPR facilitated member multi-tasking in a safer manner. With further regards to safety, because the technology emits an auditory signal when a hit occurs, as well as a visual signal colour coded based on priority, the member would primarily focus on the road and not on their computer, which could contribute to less distracted driving and greater officer and public safety.

From the members' perspective, ALPR was most efficient at catching the *Motor Vehicle Act* categories of interest, specifically unlicensed drivers, but also uninsured vehicles and prohibited drivers. Stolen vehicles were an extreme rarity for any of the members using ALPR, most could not remember a time when a stolen car had been detected while they were using the cameras. Yet, although the technology was perceived as most efficient for catching unlicensed drivers, as well as uninsured vehicles, several participants reported that they perceived the overall purpose of the technology was to help them catch drivers who should not be driving, primarily prohibited drivers. Participants stated that while uninsured vehicles and unlicensed drivers were often those who had forgotten to renew their documents, prohibited drivers are those who have specifically had their license removed due to previous violations of traffic safety (e.g. repeated speeding or drinking and driving). Given this, members appreciated the ability of the technology to facilitate more targeted policing of this particular population. Thus, they perceived that the technology allowed them to reduce the extent to which they bothered the "general motoring public" and to focus on those known to have committed a traffic-related violation.

LIMITATIONS ASSOCIATED WITH THE USE OF ALPR TECHNOLOGY

Although ALPR offers significant opportunities for increased productivity, participants reported several limitations to its use.

Stolen Vehicles

There are several reasons why ALPR is generally ineffective in detecting and recovering stolen vehicles in Surrey. As mentioned above, the hot list consists of 'old' information and the stolen vehicle is less likely to still be on the road 24 hours after it has been entered into the system for the ALPR-enabled car to pass it. Another reason is that Surrey uses a mobile version of ALPR and even though there is a camera available specifically to scan parking lots for stolen vehicles, the members report that they never use ALPR for this purpose. Thus, to detect a stolen vehicle using mobile deployment of ALPR would require an unlikely meeting in time and space between the one ALPR equipped police vehicle and the stolen vehicle. A third reason for its inefficiency in detecting stolen vehicles has to do with manpower. The more common hits are for unlicensed drivers, rarely do they receive one for a stolen vehicle. Because ALPR is only deployed in a single vehicle and that vehicle is not partnered with other vehicles that can pursue the hits, the member may not be aware that the system read a license plate from a stolen vehicle or the member may be unable to stop a stolen vehicle because they were already engaged with another vehicle associated to a less serious infraction or offence. For instance, although one participant recalled four separate occasions when a stolen vehicle was flagged by ALPR, in each of these situations, the member was already in the process of enforcing another traffic violation flagged by ALPR.[11]

Information Deficiencies

One way in which ALPR technology hits on a vehicle plate is by comparing the license plate to CPIC information. Vehicles may be flagged on CPIC for many reasons, such as the registered owner has a previous history of suicide, is a missing person, is on parole, or is under surveillance. However, the detailed reason for the hit is not automatically provided the same way "unlicensed" or "prohibited" is when ALPR "hits" on the plate. This is likely because a "CPIC other" hit alone is not a sufficient reason to pull a vehicle over. RCMP policy states that the member needs a traffic-related reason to pull the vehicle over, such as speeding or talking on a cell phone while driving. Of note, one member suggested that it was not difficult to find a reason to pull the driver over, and, that in approximately 90% of "CPIC other" hits, the driver engaged in one or more types of traffic violations, such as speeding or failing to stop at a light or a stop sign. The greater challenge is the need to query for more information on the nature of the CPIC other hit. Currently, the member must manually look up the license plate in PRIME to determine why it was flagged in CPIC and whether that reason alone is a legitimate reason to engage in a traffic stop. One member suggested they did this for about half of all CPIC Other hits. Yet, as both ALPR and PRIME are displayed on a single computer screen in the vehicle, this requires the member to first check the plate read for accuracy, then memorize the plate number, minimize the ALPR screen, activate the PRIME screen, type in the plate number, and read the information produced from their search. This is obviously a timely process, meaning that by the time the member has the required information to execute the traffic stop, the vehicle in question may already be gone. Moreover, it can be distracting and potentially dangerous for the member to

[11] It should be noted that RCMP policy would also prevent the pursuit of a stolen vehicle. Thus, although the ALPR vehicle could attempt to follow and pull over the stolen vehicle, should it flee the scene, the member would not be able to pursue it, regardless of whether they were in a marked or covert police vehicle.

do all this if the hit occurs while they are actively driving their vehicle. Having the nature of the CPIC hit displayed would help members decide whether they can and should stop the vehicle.

In addition to having the specific nature of the "CPIC other" information displayed on the ALPR screen, some members also suggested that it would be useful to have information on prolific offenders. For instance, if the registered owner of a vehicle was a "super-prolific" with over 100 PRIME files attached to their name, having ALPR flag this vehicle would allow members to engage in other forms of crime-fighting. This view is consistent with the aforementioned DDACTS approach of mapping high crime areas and high motor vehicle collision zones based on criminological theories that predict the likelihood of finding high-risk offenders in these common areas. Similar to the CPIC other hit, members using a DDACTS strategy would need to have a traffic-related reason to pull the driver over, but, as previously noted, the research literature supports the notion that prolific offenders are more likely than non-offenders to engage in more regular forms of traffic violations (Chenery et al., 1999; Cohen, McCormick, & Haarhoff, 2014; Stuster, Worden, McLean, & Stuster, 2010; Rose, 2000).

A third form of additional information that was noted as potentially useful in the ALPR system was inspection orders. When traffic members pull over a vehicle for a physical violation, such as a broken taillight, they will issue an inspection order requiring that the violation be fixed within a specific time period, such as 30 days. If the violation is not dealt with in this time period, the member can have the vehicle towed on the grounds that it poses a threat to traffic safety. Yet, despite this being a potential public safety issue, while information on work order status is available to members when they manually run the plate and this information is already held by ICBC, it is not provided in the ALPR database.

A final information deficiency noted in the interviews was that the ALPR database typically only contains information related to the registered operator of the vehicle, and not any other primary operators. Thus, if one partner is the registered owner of both family vehicles, but their partner or family member is regularly using one of the vehicles, the latter individual will not generate any hits, even if they have a problematic driving history.

Responding to Hits

As discussed above, ALPR technology can, at times, be a victim of its own success. In other words, ALPR has the potential to generate many more hits than a police officer can respond to. The United Kingdom has reduced this limitation somewhat by employing intercept teams of between seven and twelve different officers and vehicles who will respond to hits as they occur. However, this is generally not the case in Surrey. Essentially, the same police vehicle is used to scan and respond to hits. Although the technology continues to run while the member responds to a previous hit, the participants noted that they could not abandon a current stop should a higher priority hit occur. During the ride along, six hits occurred within a half hour period; however, had the member acted on the first hit, they would be committed to completing the required administrative duties associated with that hit and be unable to act on any of the other hits that occurred. More specifically, one member reflected on a situation in which he had already pulled over an unlicensed driver when a vehicle flagged as "stolen" by ALPR drove by. Because he could not legally allow a validated unlicensed driver to get into his car and drive away, he did not follow the stolen vehicle.

While he did call the stolen vehicle into dispatch in the hopes that another member would be in the vicinity, this is not often the case and, in in this particular case, the stolen vehicle did get away. Although, sometimes, members will attempt to find a vehicle that was "hit" by ALPR while they were already engaged in another traffic stop, the success rate tends to be low.[12]

Given that there were no intercept teams or other partnerships employed to respond to ALPR hits in Surrey, the effectiveness of this technology is fairly limited, as members cannot respond to many of the hits that occur, nor, given that they are operating alone, are they able to prioritize hits to ensure they are pulling the most serious violators possible off of the road. Although the system itself will prioritize the level of hit, rather than using this to guide their response, the members instead generally handle hits on a first come-first serve basis, regardless of priority. The exceptions to this would be if two hits occurred fairly close to each other in time and the member was able to decide which one to engage. However, even this practice can be limited by the need to maintain safe driving tactics. For example, a member may decide to pursue an unlicensed driver travelling in the same direction, rather than a prohibited driver travelling in the opposite direction.

Ineffective Deterrence

Members were asked whether they believed ALPR technology was an effective deterrent to prevent the general public from engaging in traffic violations. Generally, this was not the case. The participants perceived that probably few other RCMP members working in Surrey even knew about their use of ALPR technology, let alone the general public. In most cases, they believed that the public perceives the cameras on the vehicle to be extra lights. In fact, when used at night, the cameras actually generate a red light that further perpetuates this perception. Thus, although there has been some discussion in the media regarding police use of license plate technology and the availability of information on the RCMP website and the Ministry of Justice website regarding ALPR use, the participants felt that the public was generally unaware of the Surrey RCMPs deployment of this technology.

Regardless of whether the public was aware of Surrey's use of ALPR, participants felt that it still would not have much of a deterrent effect, noting that "if people are motivated to get somewhere, they're going to go, regardless of their driving status". The lack of potential deterrence is particularly likely if the public were aware that it was only located on a single police vehicle and that it rarely patrolled outside of a few key areas in the city. Furthermore, the participants acknowledged that it was easy to avoid being detected by ALPR given its current location on a marked police vehicle. Essentially, they noted that if a prohibited driver or auto thief saw the police vehicle ahead in the road, they would just take another route. As for deterring unlicensed drivers or uninsured vehicles, they suggested that increasing public awareness of the use of ALPR to detect these violations would be unlikely to increase compliance because, in the vast majority of cases, the driver simply forgot to renew their insurance, rather than intentionally trying to avoid the police.

If the use of this technology was to be better promoted to the public, members suggested that there be a concentrated marketing focus on the message that they were not simply scanning plates with

[12] Participants estimated this to be around 5%.

the hopes of generating more tickets from those who forgot to renew their insurance, but that they were legitimately trying to catch traffic violators, in particular, those who have specifically lost their license for valid reasons, such as repetitive speeding or drinking and driving. In fact, although unlicensed drivers were perceived as the most common form of violation identified by ALPR, some members emphasized that, when possible, they prioritized prohibited driver hits because these were intentional traffic violators who put the public at risk, rather than those who may have simply forgotten to renew their license or insurance.

A second reason members perceived a lack of deterrence from ALPR had to do with its location on a marked police vehicle. While the deployment of ALPR technology in a marked police vehicle provides the police with the ability to perform traffic stops, in that they can more safely execute U-Turns and other forms of traffic violations, the members indicated that given the way ALPR is currently utilized, it could be more effectively deployed in unmarked police vehicles. As previously noted, members will frequently park the vehicle in the median of a high-volume road to scan vehicles going in both directions. This increases the number of plates read, which increases the likelihood of a hit occurring, and allows the member to quickly and safely follow a "hit" vehicle. However, the members were keenly aware that people who knew they were violating traffic rules would likely turn off the road before their plate could be scanned. If they were able to deploy ALPR in a regular unmarked police vehicle, participants believed that the number of successful hits would be higher, especially for the more serious violators, such as prohibited drivers or drivers of stolen vehicles. However, RCMP policy appears to prevent covert vehicles from conducting traffic stops as they are not properly equipped to do so. Still, moving the technology to an unmarked or covert vehicle that could be partnered with at least one marked police vehicle to conduct pursuits could increase both the current effectiveness of ALPR in detecting traffic violators and the future deterrent effect that might result from increased public awareness from an improved number of stops made as a result of ALPR detection.

It should be noted that as currently deployed in Surrey, ALPR also does not have a deterrent effect on other crimes. Despite growing awareness about DDACTS, ALPR is not deployed in a manner that specifically facilitates the detection of known criminals. It was acknowledged by some participants that ALPR could be used for other crime related enforcement purposes, such as the detection of prolific offenders, but that this potential application has not been approved by E-Division Headquarters, likely as a result of interpretations of the *Privacy Act*. Thus, given the lack of crime-related data to generate hits, ALPR is not currently effectively used for broader crime reduction purposes.

Recommendations

As a result of the review of the literature, the quantitative analysis of reads, hits, and action taken using ALPR in Surrey, and the qualitative interviews focusing on the use of ALPR by Surrey's traffic services unit, this report provides ten recommendations to enhance the efficiency and effectiveness of the ALPR program in Surrey.

RECOMMENDATION 1: MORE REGULAR AND BALANCED USE OF THE ALPR-EQUIPPED VEHICLE

A major limitation in the current use of ALPR technology in Surrey is that it is on the road for only a minority of shifts. Currently, there are more members trained on ALPR than are regularly using the technology. Although there is an implicit understanding that everyone has their own car and there is a general dislike of moving people's personal items around, that understanding should be put aside in this situation. There is no reason why ALPR should not always be in operation in Surrey. As noted, one of the assigned members was on leave for an extended duration, yet in their absence, no one else was assigned to use the ALPR-vehicle. In the meantime, there were other members available in the unit with this training, and, if possible given the other responsibilities of this unit, one of them could have been temporarily assigned to the vehicle to replace the member on leave. Short of assigning another member to the vehicle, those who have received this training should at least be expected to use the vehicle more regularly when it would otherwise be sitting idle for a shift.

One way of encouraging more regular use of ALPR would be for senior management to make daily assignments to the vehicle when the regularly assigned member does not already schedule it for use. Another way of encouraging more use of ALPR is to respond to the perception that using ALPR must result in an increased workload. Specifically, several participants reported that the perceptions of the required end-of-shift paperwork generally deterred other traffic members from wanting to be assigned to this vehicle.[13] As previously noted, the only difference between the paper log and the electronic transfer is the assignment of a file number to the hit that is noted in the paper log. Thus, to reduce apathy against using the technology amongst those already trained and encourage more regular use of the ALPR-equipped vehicle when available, software updates should be requested from the service provider that will allow for an assignment of a file number to the ALPR records. This would eliminate the need for a separate paper log to be written at the end of each shift. Adding the program to another workstation in the detachment is also recommended, given that the program can be freely loaded onto more than one workstation. This might address the concern mentioned by those members who stated that it was a deterrent to ALPR's use when the one station it was loaded onto was already in use when they started their shift. In addition, if the navigation between the ALPR hot list and PRIME was more streamlined, this might also increase the use of ALPR because, currently, they are both displayed on a single screen in the vehicle making it difficult to pull further information on a vehicle of interest from police records, particularly when driving to follow a vehicle of interest. One way to do this would be to add a second computer terminal to the ALPR vehicle that only displays the ALPR hits leaving PRIME open on the other mobile data terminal. Alternatively, as suggested later in the recommendations, assigning a support person to the ALPR-equipped vehicle could help reduce the additional demands required by ALPR operation.

[13] It should be noted that this paperwork does not need to be completed at the end of the shift, it can actually be completed throughout the day, each time a hit occurs.

Although ALPR is not being used to its fullest extent in Surrey, all participants agreed that having more members trained and available to engage in ALPR-led traffic enforcement would be welcome. In fact, previous studies have acknowledged that given the increased workload generated by ALPR hits, staffing levels for ALPR vehicles should be increased beyond conventional staffing levels for traffic units (PA Consulting, 2004; Schuurman, 2007). Although the exact number of personnel required for efficient deployment of ALPR has not been determined, the 2003 evaluation of ANPR in the UK reported that the intercept teams were composed of an average of one Inspector/Sergeant, seven constables, and half an administrative assistant (PA Consulting Group, 2003). In the current study, it was suggested that an ideal ALPR team would consist of one sergeant or corporal in charge and five members to intercept the hits. The team would be deployed in areas of high collision rates as the visibility of the team would help to lower dangerous driving, as well as high crime areas, where there would be an increased likelihood of detecting crimes like break and enters or stolen vehicles and where the saturation of marked police vehicles might also deter crimes from occurring. Importantly, creating an ALPR intercept team would allow for the cameras to be moved off of the marked police vehicle and onto an unmarked or covert vehicle, as the ALPR-equipped vehicle would no longer be required to follow up on the hits, something that is currently prohibited by RCMP policy when driving a covert police vehicle. As will be discussed below, moving the cameras to an unmarked or covert vehicle may allow for greater detection of the more serious offenders, primarily auto thieves and prohibited drivers. In terms of deployment of the ALPR intercept team, the research suggests that an ideal deployment would be randomly targeting hot spots identified using crime analysis. As previously discussed, the criminological theory underlying the DDACT strategy suggests that targeting areas with high crash rates and high crime rates (particularly property crimes) will increase the number of offenders intercepted by such units. However, the ALPR team should keep in mind the Koper principle that identified diminishing returns after a certain amount of time (12 to 15 minutes) spent in one area. Thus, the team could be deployed to temporarily saturate a hot spot, pull a series of vehicles over based on their hit results, and then move on to another hot spot.

Another way of ensuring more regular use of ALPR technology in Surrey is to purchase a second set of cameras to install on a second vehicle used on the opposing watches/traffic teams. As noted in the summation of interview data, there are two members currently assigned to the ALPR vehicles; these members are on watches/traffic teams that run on opposing days (e.g. Watch A and Watch C) so that there is no conflicting overlap when shifts run late/start early. Purchasing a second set of cameras would allow the other two watches/traffic teams (e.g. Watch B and Watch D) to be assigned to a second ALPR-equipped vehicle. If each watch/traffic team had access to an ALPR-equipped vehicle, the technology would be deployed up to 24 hours seven days a week, rather than the current situation where it is run approximately 12 hours for four days of the week. Given that approximately 1% to 2% of all plates read will generate a hit, deploying the technology across two vehicles would mean that the traffic unit could detect and potentially respond to between 60 to 80 traffic violations a day, more if the hot lists were expanded to include other categories of actionable interest to police. Assigning intercept teams to each watch/traffic team would increase the number of hits the unit could respond to, and would also allow for prioritization of hits.

Ideally then, two ALPR-vehicles would be used across the four watches/traffic teams, and one intercept team composed of a sergeant/corporal and six constables would be created out of each

watch/traffic team. However, this is a substantial increase from the current situation and purchasing another set of cameras may be difficult to justify given that the available technology is not already being used to its fullest extent. Surrey may want to first consider piloting a single intercept team to determine the extent to which it increases both the effectiveness and efficiency of the technology. Of note, IRSU has an ALPR vehicle that can be requested for use by RCMP detachments; thus, if Surrey wanted to test the efficiency and effectiveness of this proposed model of full-time ALPR deployment across the four watches/traffic teams with assigned intercept teams, they could potentially borrow this vehicle for use by the second set of watches/traffic teams.

In addition to more regular use of the ALPR vehicle(s), the balance of ALPR deployment could be improved. The data study consistently revealed patters of over- and underuse during particular times of the day, days of the week, and months of the year. These patterns represent a type of inefficiency in the allocation of a limited resource. ALPR should not be employed as matter of convenience. Hit rates may be improved by redistributing ALPR usage. At the same time, it is important to avoid overcorrections. More routine analysis of ALPR data could monitor ongoing hit rates and provide more regular feedback that could aid in deployment decisions.

RECOMMENDATION 2: USE VOLUNTEERS FOR ADDITIONAL MANPOWER

Surrey may not have the resources or justification to add a second vehicle equipped with ALPR technology at this time, and assigning more sworn members may not be feasible given the other public safety demands made of the detachment. However, an alternative solution might be to use citizen personnel or volunteers in place of sworn members. For instance, there was a previous program running with IRSU where the ALPR-equipped vehicle was driven by an auxiliary member who then called the hits into traffic members for enforcement. This practice ended around three to five years ago. During the interviews, it was speculated that the program was cancelled due to poor training that lead to administrative errors. If Surrey was to pilot an ALPR intercept team, they might consider using an auxiliary member to drive the ALPR vehicle and using a volunteer (either auxiliary or from a volunteer group such as Citizens on Patrol) to monitor the incoming scans and dispatch the marked police vehicle for enforcement. However, while section 3 of the RCMP policy on ALPR use does not identify any qualifications for use of the ALPR technology and, in fact, in the RCMP policy on ALPR, there is no definition provided of the ALPR operator, the *Terms and Conditions of Participation* as drafted by "E" Division RCMP notes that "[b]y signing the Letter of Agreement the policy agency will: [e]nsure that ALPR is operated only by Regular Members or sworn police members and not by other categories of employees or volunteers" (RCMP "E" Division Traffic Services, nd). In order to facilitate the efficient use of ALPR technology in Surrey, the Surrey RCMP may want discuss the possibility of an amendment to these terms with "E" Division RCMP.

Even without developing an ALPR intercept team, there are other ways volunteers could be integrated into this policing strategy. For instance, the traffic services unit could partner the RCMP traffic member assigned to the ALPR vehicle with an auxiliary constable. There are three potential uses for this partnership. First, the auxiliary could observe the data coming in from the cameras for accuracy and should they notice a misread, they could manually query the misread plate to determine whether it is in fact on the hot list. There is a demonstrated need for this, given that

during the brief observation of ALPR made for this current study, a substantial number of misread non-hit plates were observed by the interviewer that were not coming to the attention of the traffic member as they were paying attention to the vehicles on the road.

Second, given that auxiliary constables have access to PRIME and CPIC information, they can run additional queries on hits resulting from the CPIC Other category while the driving member can focus on following the vehicle in question. Preferably, additional information on the nature of the CPIC Other hit would be provided automatically on the ALPR screen (see Recommendation 4); however, if it is not possible to expand this information, assigning a partner who can query this information while the member drives the vehicle would be helpful. If possible, installing a second MDT in the ALPR equipped vehicle for use by the auxiliary would be helpful to facilitate this partnership.

Third, given that some members perceived that the end-of-shift paper log was a deterrent to taking out the ALPR vehicle, this task could be shifted to the auxiliary member to complete. The auxiliary could also be given the responsibility of transferring the hot list to the vehicle software in the morning and transferring the hit and generic non-hit data back to RCMP E-Division headquarters at the end of the shift. The auxiliary could also assist in completing the paperwork associated with acting on a vehicle from the hot list. Currently, it takes the member between 30 to 45 minutes to deal with a hot listed vehicle; however, allegedly, this time could be cut in half if there was an auxiliary to help fill out the violation ticket or other paperwork while the member writes their report. This would be helpful both in the case of a single ALPR vehicle operating on its own or, if the RCMP implemented an ALPR intercept team, each constable assigned to conduct intercepts could be assigned an auxiliary partner to help speed up the response to hits and allow for more actionable responses to occur.

Another way that volunteers may be used to enhance the program in Surrey was suggested by Schuurman (2007) as a result of her study on the use of ALPR to patrol parking lots in Surrey. She suggested that volunteer groups, such as Citizens on Patrol, could use the ALPR vehicle to search for abandoned stolen vehicles. Specifically, they could take the vehicle out to patrol parking lots in high crime areas. Should they detect a parked stolen vehicle, they could call the hit into dispatch who could then send a marked car to investigate. This could be an alternative way to deploy the ALPR vehicle when not in use by an assigned member that will ensure the technology is being utilized more often in Surrey.

RECOMMENDATION 3: MORE STRATEGIC DEPLOYMENT OF ALPR TECHNOLOGY

Currently, when the traffic services unit uses the ALPR vehicle, it is taken out and used as a silent partner in the background. In effect, it is typically left to run in the background while the traffic member performs their routine patrols. On occasion, the member will specifically take the vehicle to a high traffic volume area to run ALPR and detect hits. However, both the research literature on ALPR use and the discussions held during the interviews identified more strategic ways to deploy ALPR technology in Surrey.

One way to improve the strategic deployment of ALPR is to run more traffic enforcement blitzes using this technology. This will have the dual benefit of catching violators and publicly demonstrating the effective use of this technology, which may have a deterrent effect on some forms of future violations, such as prohibited driving or driving stolen vehicles.

As discussed above, one participant had previously been involved in successful strategic strike-team types of ALPR deployment that generated substantial numbers of plate hits. However, there is currently insufficient manpower to run such strategies. As noted, this strategy was deployed using teams of six vehicles. Currently, traffic services is composed of three-vehicle teams and given the length of time needed to complete the associated paperwork (e.g., PRIME files, appearance notices), and the fact that drivers who are unlicensed, uninsured, prohibited, or unable to drive for other reasons (e.g., intoxicated) cannot simply be allowed to continue on their way and that a tow and alternative transportation must be arranged, it could take between 30 and 45 minutes to deal with each vehicle. This is one reason why developing an ALPR intercept team with five vehicles is suggested; this would maximize the ability to respond to multiple hits. However, if a permanent team is not feasible, Surrey RCMP might consider running periodic blitzes of this nature from time to time.

One way to increase effectiveness in detecting violations is to run these blitzes based on event-related deployment. For instance, one participant suggested running ALPR during roadblocks, such as those commonly put in place around Christmas and New Years or following major sporting events. In fact, ALPR has previously been used in British Columbia for road checks (Gaumont & Babineau, 2008), but, presumably, this no longer occurs on a regular basis because of manpower restrictions. This can be a useful application of ALPR as traffic members are primarily focused on the drivers, looking for signs of intoxication, and do not have time to manually check licenses and run the license plates of all drivers coming through a roadblock. Therefore, positioning an ALPR-equipped vehicle at the start of the roadblock would help members to identify other traffic violators who are not often detected by roadblocks.

Although such deployment has occurred from time to time in Surrey when they have had sufficient resources, given the current composition and staffing levels of the unit, Surrey RCMP traffic services does not have the manpower to run such enforcement blitzes alone on a regular basis. However, they could facilitate this strategic deployment on a more regular basis either by temporarily transferring non-traffic members to assist them for several hours of traffic-related work (e.g., to intercept the hits generated by ALPR), by having the City occasionally approve the use of overtime by members to engage in these blitzes, by assigning more members to the traffic unit, or by requesting that IRSU partner more regularly with Surrey traffic services in conducting these types of enforcement blitzes.

In addition, ALPR could be used strategically to gather information on vehicles in the area of major public events. Throughout the year, the City of Surrey runs several major events, including on Canada Day, the Pride Festival, the Vaisakhi Parade, and Earth Day's Party for the Planet. As these types of events provide criminal opportunities, there may be utility in having the ALPR vehicle scan the license plates of vehicles in proximity to the event, both for preventative (in case a vehicle of interest is detected) and investigatory (e.g. in the event that a major crime occurs) purposes.

As noted, Surrey RCMP's current use of ALPR is primarily as a silent partner, rather than as a primary enforcement tool. As it is currently deployed, members operating the ALPR vehicle will turn on the system at the beginning of the shift after which they will drive to areas where they know traffic volume is likely to be high. In effect, they are waiting for hits to come to them. Given that previous research has found a greater number of hits occurs in areas of high traffic volume (e.g. Cohen et al., 2007), this method should increase the likelihood of hits. However, the likelihood of detecting higher priority hits (e.g. prohibited drivers, stolen vehicles) would be increased by more strategically deploying the technology to areas where criminals are known to be – i.e., hot spot policing based on information provided by crime analysts (Koper et al., 2013; Lum et al., 2010; Lum, Koper, & Telep, 2011; Ozer, 2010). Thus, crime analysts should play a key strategic role in the deployment and use of the ALPR-enabled vehicle to contribute to more effective and efficient proactive patrolling.

Research has consistently established that hot spot policing that "focuses on the geographical concentration of crime" is "one of the most successful interventions evaluated for crime prevention and deterrence" (Lum et al., 2011: 325). Although stolen vehicles are unlikely to remain in a hot spot, as they are frequently used to facilitate crimes in other areas or for transportation between cities (McCormick, Plecas, & Cohen, 2007), the distance between where a vehicle is stolen and where it is later recovered is often quite short (Lu, 2003; Lu & Thill, 2003). This suggests that law enforcement agencies should police "hot routes" for stolen vehicles (Lum et al., 2010; Taylor et al., 2012). Thus, crime analysis identifying pathways between where stolen vehicles are often taken and recovered in the city should help Surrey's traffic services unit to more effectively apply ALPR to stolen vehicle detection by guiding them to relevant hot routes within the city. Furthermore, considering Schuurman's (2007) finding that hits in parking lots were greatest between 3pm and 7pm on weekdays, and that large parking lots are a common location to dump a stolen vehicle, crime analysts could direct the ALPR vehicle to be deployed to particular parking lots at particular times to search for stolen vehicles. In addition, knowing that stolen vehicles are often used to facilitate other crimes, such as break and enter offences, crime analysts could also direct the ALPR vehicle to current property crime hot spots in the city where the potential for stolen vehicle detection may be increased.

Although ALPR is currently only used in Surrey to detect stolen vehicles and a limited range of traffic violations, the RCMPs policy on ALPR use states that "Automatic License Plate Recognition is an investigative aid that can significantly improve road safety, significantly reduce property crime, increase patrol efficiency and increase detection rates of target plates" (section 1.1). Further, section 1.5 states that "ALPR is approved for the prevention and detection of stolen vehicles, detection of provincial traffic violations, and is effective for all types of criminal investigations where a vehicle link is possible or probable". Given this, it appears that there is a foundation for ALPR to be used strategically by crime analysts and to be a part of the detachment's emphasis on being intelligence and information-led to enhance public safety and improve criminal investigations. For instance, a crime analyst could suggest that the vehicle patrol near a residence known for domestic violence calls for service if the perpetrator had recently been given a no contact order. If the license plate associated with that offender is photographed in the vicinity of the residence, this would provide the Domestic Violence Unit with useful information to further their investigation or that can put additional pressure on the offender to comply with the restrictions on

their mobility. In a similar application, a crime analyst may have detected a particular pattern regarding the movements of gang members in the city. They could then direct the ALPR-equipped vehicle to drive by a location known to be frequented by gang members to capture images of their plates confirming their presence on scene that could be used to further an ongoing or later investigation. These are just two of the potential strategic uses of ALPR for investigatory purposes. However, for these strategic deployments to be made, changes would need to occur to the nature of the hot lists to allow for the inclusion of license plates associated with known criminals, rather than primarily only those associated with traffic violations. This will be discussed further in Recommendation 4.

Despite the presence of a camera specifically for use in parking lots, the ALPR vehicle is not currently used to patrol parking lots. Given Schuurman's (2007) previous findings regarding the utility of ALPR in parking lots (approximately four hits an hour), this may not seem concerning. In fact, if there is no change to the current deployment of ALPR and if it poses an unnecessary cost to purchase and maintain this camera, then the Surrey RCMP should consider discontinuing its use. That said, Schuurman (2007) suggested that ALPR could strategically be deployed in parking lots in Surrey during early evenings (between 3pm and 7pm) as this was the time period during which three-quarters of all parking lot hits occurred. In fact, one-third of all parking lot hits occurred just between 4pm and 5pm. Furthermore, while Schuurman tested the utility of this fixed camera in 31 different parking lots in Surrey, her results indicated that the majority of hits came from just five locations, including Guildford Town Centre, Surrey Central SkyTrain Station, and the Strawberry Hill lot (Schuurman, 2007). Thus, if the Surrey RCMP would prefer to use this particular camera, they should consider developing a strategy for use around her original findings. An additional consideration is Lum and colleagues (2010) suggestion of the "sweep and sit" method, whereby officers "sweep" a hot spot, like a parking lot, for vehicles that may be on the hot list, then park for 12 to 15 minutes (using Koper's Curve Principle of diminishing returns on deterrent effects of hot spot policing) before moving on to another randomly selected hot spot. A third consideration in regards to this strategy is that the use of a sworn member to routinely drive the ALPR-equipped vehicle through parking lots to capture information on vehicles of interest is not the most efficient use of a trained member's time. Instead, if the vehicle would be used to detect stolen vehicles, or perhaps to capture information for use in other later investigations, the Surrey RCMP could assign a trained auxiliary member or other volunteer to carry out this strategic deployment. In effect, given Schuurman's findings, as well as Recommendation 2 in this report, the traffic services unit should consider assigning volunteers to use the vehicle to patrol certain parking lots for stolen vehicles during the early evenings when the vehicle is not already in use by an assigned sworn member.

Importantly, Schuurman's findings also determined that one-in-ten vehicles "hit" in parking lots in Surrey were associated with a registered owner who had a criminal history. Given this, there might be some utility, for investigatory purposes, to use ALPR in parking lots, particularly in the early evening. In fact, Surrey could consider specifically using the parking camera strategically to capture images of vehicles parked in particular locations of interest, such as the parking lots of restaurants or bars known to be frequented by gang members. In the past, this data would be held for 90 days and therefore could be of some use for other investigations; however, E-Division no longer holds non-hit data, and so this policy would need to be amended. A further limitation is that the

perception among interviewed members was that other RCMP members in Surrey are generally unaware that ALPR is being used by traffic services and that this potentially useful data even exists.

Until ALPR is more strategically deployed in Surrey, purchasing additional ALPR technology is likely not the best use of the detachment's limited resources, especially given that each unit costs approximately $30,000. That said, if detection of stolen vehicles is one of the Surrey RCMPs main intentions in using this technology, they may consider, as Schuurman (2007) recommended, purchasing a set of stationary cameras that could be located along major traffic intersections, at high volume parking lots, such as Sky Train stations, shopping malls, or at the major transportation routes into and out of the city. However, although the use of fixed cameras along popular routes could increase the chances of detecting stolen vehicles, there are two major caveats to this application. First, auto thieves could quickly determine where cameras are located and use alternate routes in, out, and through the city. Second, given the difficulties of using real-time data, the databases of interest would still contain only historical data that have limited application to stolen vehicles. Thus, purchasing additional stationary cameras is not recommended unless there is an ability to move the cameras around through the city and upload real-time data.

An alternative way to potentially increase the application of ALPR to stolen vehicles, and which would also improve the current hit rate of the ALPR equipped vehicle more generally, would be to move the current ALPR technology to an unmarked or covert police vehicle. This should increase the chances of detecting the more serious and intentional forms of traffic violations, as these drivers are the ones likely to take another route if they spot a marked police vehicle nearby. Although the participants suggested that a covert vehicle would be best[14], as these vehicles are more similar to the other vehicles on the road, an important caveat to this is that either a policy amendment would also be required or there would need to be a change to the deployment of ALPR. Specifically, section 3.4.1 of the RCMPs policy on ALPR use states that "members operating covert ALPR vehicles must not stop, or attempt to stop, a vehicle or person". Thus, if ALPR was moved to a covert vehicle, they would need to either amend the policy to allow covert vehicles to make a vehicle stop or, more likely, amend the way ALPR is deployed to use a partnered marked police vehicle that would be assigned to follow and intercept hits identified by the covert vehicle. Thus, this strategy would work well in conjunction with the strategies discussed in Recommendation 1, the development of an ALPR intercept team. Alternatively, the technology could be moved to an unmarked police vehicle; however, these are less conspicuous than covert vehicles, and they are still subject to additional limitations, such as being prohibited from making illegal U-turns.

RECOMMENDATION 4: EXPAND THE ROLE OF ALPR

While the currency of the information held in the hot lists was to the members' satisfaction, there are other sources of information that may expand the utility of ALPR. Currently, ALPR is used in Surrey primarily to detect traffic violators, as well as to detect and recover stolen vehicles. However, some improvements can be made both to how the information of interest is conveyed to

[14] In one interview, a minivan was suggested and in another a Dodge charger. One participant noted that the cameras could be disguised using a roof rack on top of the covert vehicle.

the members, as well as to the type of information that is used to generate hits. It is important to acknowledge the IACPs caution that law enforcement agencies restrict the number of databases for comparison against ALPR images, otherwise officers will likely be inundated by more hits than they can effectively respond to (IACP, 2009). Thus, to make the following suggestions feasible, they should be considered in conjunction with the strategies discussed in the first recommendation, primarily the development of an ALPR intercept team.

The review of the literature on ALPR revealed a potential application of ALPR beyond responding to traffic safety. ALPR has been used very successfully in other jurisdictions, including several American states, as well as nationally across the United Kingdom, to enhance criminal investigations. For instance, ALPR is used to patrol the outskirts of important locations to collect plate data on vehicles in the vicinity of potentially vulnerable targets. Even without targeted patrols, the data collected by ALPR can be used to further other criminal investigations, such as homicides or attempted homicides, break and enters, or arson, by revealing the plates of vehicles in the vicinity of the crime around the time that it was suspected to have occurred.

Another way that ALPR could be used by Surrey to enhance investigations is to proactively deploy it to assist other units in their investigations. For instance, Surrey has faced recent issues with the proliferation of gangs (Davies and Cohen, 2014a; 2014b); thus, uploading the license plates of known gang members can help Surrey's Gang Enforcement Team to monitor their movements and activities.[15] While uploading their license plates to the hot list would not necessarily allow the member to take any action against the driver unless they committed a traffic violation, such as driving while operating a mobile phone, a hit would be generated and, under current policy, a record of the location, date, and time of the hit would be kept for a two year period. This information could be useful in the context of a later investigation, or as discussed in a later recommendation, could be used by a crime analyst to uncover patterns of interest to police. Similarly, by adding the license plates of known drug offenders to the hot list, ALPR may be able to assist in mapping out the transit patterns of drug offenders, which can help generate a picture of the crime patterns in the city (Ozer, 2010). Similarly, ALPR could be used to enhance the investigations of the Domestic Violence Unit. This unit is assigned to investigate serious cases of domestic violence and monitor high-risk domestic offenders. They could benefit from the occasional crime analysis of ALPR non-hit data and specific deployment of the ALPR vehicle to check that high-risk domestic offenders who have restrictions on their movement are not in locations they are prohibited from entering.

Although information on these types of individuals is not currently available in the database, an argument could be made for their inclusion given that individuals subject to court-ordered restrictions on their movement have a reduced expectation of privacy and that Acts, such as the

[15] Of note, the province's Combined Forces Special Enforcement Unit's Gang Task Force and the Real-Time Intelligence Centre could also benefit from this information, particularly if it were provided with information from ALPR units across the province. However, this would require the development of data sharing protocols specifically around ALPR data and would not be a Surrey RCMP specific initiative. Given this, this potential application is not discussed further in this report.

provincial FIPPA, consent for the collection of personal information for law enforcement purposes, including the generation of investigatory leads (Denham, 2012).

Although ALPR has the potential to assist specialized units in their investigations, it should be noted that in the provincial privacy commissioner's review of ALPR use by the Victoria Police, it was recommended that non-actionable information be removed from the ALPR hot list. Specifically, the privacy commissioner recommended that information that alone could not be used to justify a traffic stop, such as a previous history of suicide, be removed from the hot list as it was irrelevant to the purposes of ALPR. That said, the federal privacy legislation provides law enforcement agencies with the grounds to collect personal information, such as license plates, for law enforcement purposes. Although the federal *Privacy Act* does not specifically define law enforcement, Schedule 1 of the British Columbian *Freedom of Information and Protection of Privacy Act* defines law enforcement as "(a) policing, including criminal intelligence operations; (b) investigations that lead or could lead to a penalty or sanction being imposed; or (c) proceedings that lead or could lead to a penalty or sanction being imposed". Given this, and the fact that the *Privacy Act* approves the collection of personal information for use that "relates directly to an operating program or activity of the institution" (Section 4), the RCMP may be able to successful argue for the expansion of ALPR purpose to include criminal investigations. However, given that this change would require an amendment to RCMP policy, this is a change that will need to be made at the federal RCMP level rather than by Surrey alone.

Another way to increase the potential application of ALPR is to add a prolific offender category to the list of potential hits. Given that these individuals have accumulated a long list of prior offences and that such offenders are more likely to engage in traffic violations, it could be useful for police to know when a vehicle registered to a prolific offender is nearby. Although this would not be sufficient grounds to pull over the offender, the interview participants acknowledged that it is not uncommon for drivers to commit one form of traffic violation or another. In other words, it would not be difficult to justify stopping a known prolific offender, and this stop would actually be consistent with the Prolific and Other Priority Offender policing strategies popular in the United Kingdom that are having demonstrable positive effects on crime reduction. In effect, conveying to certain members of the public (prolific offenders, known gang members, high-risk offenders) that police are paying close attention to their actions appears to deter, or at least displace, offenders from committing crime in that area (see Cohen, Plecas, McCormick, & Peters, 2014 for a review of this and other effective policing strategies). Of note, the City of Surrey recently recommended in its Crime Reduction Strategy that ALPR be used to detect priority crimes and offenders (http://www.surrey.ca/files/Crime_Reduction_Strategy.pdf), therefore, it appears that the Surrey RCMP has the opportunity to make this change.

RECOMMENDATION 5: EXPAND THE INFORMATION PROVIDED FOR CPIC OTHER HITS

As noted above, there is a "hit" category for CPIC other, which includes a variety of people and vehicles of interest to police. The specific reason for this hit is not automatically provided to the member, although they have the ability to manually look it up in PRIME. However, in the time it takes to research this information, which requires flipping back and forth between the ALPR and

PRIME screens, the vehicle in question may have disappeared before the member has determined that they have the grounds to stop the vehicle. Since police already have the ability to look this information up manually, an argument could be made for making this an automated process, particularly for those individuals for whom the CPIC flag could justify a traffic stop, such as a license plate associated to a missing person. The finding that one-fifth of all hits occurring in Surrey between 2012 and 2014 were for CPIC Other indicates the need for this kind of adjustment.

Of note, the provincial privacy commissioner previously recommended that this list be restricted to categories directly related to the purpose of ALPR. Presumably this has not occurred, which is why CPIC flashes require further manual investigation. If possible then, the information provided to generate the hot list should only include categories related to the purpose of ALPR, perhaps expanding to prolific offenders or known associates of offenders should ALPRs purpose be broadened to comprise investigations. Subsequently, the nature of the CPIC hit could then be provided on the ALPR screen similar to the nature of a traffic violation, reducing the time required to consider making a traffic stop and reducing the extent to which the driver is distracted by conducting a manual search on their computer.

RECOMMENDATION 6: USE NON-HIT DATA FOR INVESTIGATIVE REASONS

E-Division RCMP Headquarters does not retain non-hit data, with the exception of very basic information ("metadata") used to calculate hit statistics. In other words, when it comes to non-hit data, the only information that is kept is the fact that a scan occurred and it resulted in a non-hit. No personal information (e.g. licence plates) is kept past the end of each shift when the data is pulled off the car's system. In the past however, non-hit data used to be retained for a 90 day period and as previously discussed in the literature review, non-hit data is retained for longer periods in a variety of other jurisdictions. During this time, this information could potentially be used by crime analysts to enhance ongoing investigations. As previously noted, a crime analyst might be able to detect violations being committed by known offenders, such as domestic violence offenders who have a no-contact order. By regularly running checks of their license plates against collected non-hit data, crime analysts might be able to check that offenders are abiding by their conditions. In other applications, using this data, a crime analyst could identify that a particular license plate was regularly in the vicinity of property-related crimes, thus generating a potential lead for investigators to follow. Alternatively, network analysis could reveal that one or more vehicles was associated with a vehicle already flagged to police, for instance, in the case of gang members. Crime analysis of ALPR data may therefore generate more leads for investigators and provide investigators with information to help increase compliance among their target population of offenders.

As it is currently written, the Terms and Conditions of Use provided by E-Division state that police agencies must ensure that ALPR is not used for the collection of intelligence or other non-authorized operational or administrative purposes. Yet, given that the Surrey RCMP is striving to be information- and intelligence-led, an argument could be put forth in support of this use. Although license plates are considered personal information, section 4 of the *Privacy Act* allows personal information to be collected by government institutions if it relates directly to "an operation

program or activity of the institution". Given that crime analysis is an operation commonly employed by RCMP, an argument could be made for the analysis of license plate data. However, there are two potential limitations to this use of non-hit data. Firstly, the provincial privacy commissioner found that the collection of personal information by a municipal police force was only justified for law enforcement purposes, and that "collecting personal information for law enforcement purposes does not extend to retaining information on the suspicious activities of citizens just in case it may be useful in the future" (Denham, 2012: 3). A decade ago, a similar argument was made by the federal privacy commissioner regarding the use of closed circuit television (CCTV) monitoring public places by the RCMP. In a submission to the Supreme Court of British Columbia, the Privacy Commissioner of Canada argued that "continuous, non-selective monitoring is a violation of the Privacy Act" and that "indiscriminate video surveillance in the absence of cause" violates several sections of the Canadian Charter of Rights and Freedoms (sections 2d, 6, 7, and 8), as well as international conventions (Article 12 of the United Nations Universal Declaration of Human Rights and Article 17 of the International Covenant on Civil and Political Rights) (as discussed in Deisman, 2003). Thus, the public and courts are unlikely to support analysis of non-hit data as it applies to individuals who have not committed a violation.

Secondly, in order to engage in crime analysis of non-hit data, the disclosure policy around this information would need to be modified. In the United Kingdom, although non-hit data is generally retained for two years, the database is only accessible to police for 90 days. After that point, police must make an application to access the information (Watson & Walsh, 2008). Similarly, RCMP policy requires police to submit a request to search the ALPR database; notably, this request must include the license plate of interest, the reason for the requested search, and an associated file number the search is linked to. Thus, consistent with the United Kingdom, where police are only permitted to analyse the database if they suspect someone has committed unlawful behaviour (Watson & Walsh 2008), RCMP detachments are likewise unable to mine the data for patterns that might suggest suspicious activity (Watson & Walsh, 2008; RCMP Policy on ALPR). This means that while crime analysts with the RCMP should be able to analyse the database for offender-specific reasons, such as to identify violations of geographical restrictions on an offenders movement, to potentially locate a wanted offender, or to identify drug houses associated with known drug offenders, they are unlikely to be able to analyse the data to link crimes, such as by identifying repeat license plates near a series of seemingly related offences. Furthermore, Gierlack and colleagues (2014) noted that, in the United States, the courts have not yet determined whether the use of license plate recognition technology to track the movements of vehicles constituted a "search". If so, its use may be limited to situations where a warrant has previously been obtained to track the vehicle.

Should the restriction on the ability to data mine non-hit data change, it would be best to conduct such analysis at a headquarters level, given that vehicles often move between geographical boundaries and scanning plate data captured from more than one jurisdiction may yield crime trends and other patterns of interest not otherwise detected (Gierlack et al., 2014). One option would be for E-Division's ALPR program to coordinate directly with British Columbia's Real Time Intelligence Centre (RTIC) whose general mandate is to support and enhance police investigations in British Columbia. Ideally, by streaming live read data into the RTIC, or at the very least sending a database update of ALPR reads from all ALPR-equipped vehicles in the province, RTIC analysts

could mine the non-hit data to describe crime trends, identify persons of interest, exonerate innocent people, or help investigators solve crime. As an example, if a stabbing were to occur in a British Columbia city, analysts could review ALPR data from that city to determine if a suspect vehicle was in the vicinity of the offence near the time that the offence happened. Integrating stationary cameras, such as those lining the entrances of major commuter bridges and major intersections, into a larger ALPR network would further enhance this application; however, for this application to be effective, the retention period of non-hit data would need be at least 30 days, if not one or two years (Gierlack et al., 2014). Of note, following a review of global practices, Armstrong and colleagues (2010) previously recommended a one-year retention period for non-hit data in British Columbia (2010).

The provincial privacy commissioner found that disclosure of non-hit data was not justified under FIPPA as it did not serve a law enforcement purpose. However, if a member has a reason to believe a particular vehicle is somehow related to crime, they or a crime analyst should be able to legitimately make an application to search either the hit or non-hit databases. Given that requests of this nature may overwhelm the ALPR coordinator, the RCMP may want to consider opening the database to law enforcement related searches by all officers, similar to the practice in the United Kingdom, or to a select few who have received further training on privacy issues (Gierlack et al., 2014). Again, storing the ALPR database of plate reads at a location like the RTIC would limit access to the data to a select few people, while simultaneously having the capability to provide data to police throughout the province who could make official requests and receive approval for database searches. However, this is a change that would need to be made by "E" Division RCMP as retaining non-hit data and allowing access to the data to police officers is prohibited by the way their policy is currently written.

RECOMMENDATION 7: MAINTAIN THE "HISTORICAL" NATURE OF DATA, BUT AMEND THE POLICY REGARDING THE MANUAL ADDITION OF "NEW" LICENSE PLATES

The Surrey RCMP does not use "active" license plate data or real-time data. The members did not perceive the use of "historical" data to be an issue. Instead, they identified potential issues with transitioning to a real-time system. Although it results in limited application to detecting stolen vehicles, given Surrey's current application of ALPR primarily to traffic safety issues, the use of approximately 24-hour old data is not problematic and it is recommended that no change be made at this time to the historical nature of the hot list. However, to be more effective against stolen vehicles, it is likely necessary to augment the current process to include real-time additions to hot lists. It is possible, under very limited circumstances, to manually upload license plate information into the hot list. Specifically, in Section 3.1.1. of the RCMP policy on ALPR, if an Amber Alert occurs, a police officer can modify the current hot list to include the associated vehicle's information (see Denham, 2012; Gaumont & Babineau, 2008). Of note, policy prohibits any other type of modification to the database. However, amending the policy to allow for periodic uploading of other relevant plates is recommended to enhance the application of this program to detecting stolen vehicles. Given that the program's applicability to stolen vehicles is limited specifically as a result of the 24 hour nature of the data, allowing a member to manually enter the license plates of recently

reported stolen vehicles could increase the successful detection and recovery of stolen vehicles in Surrey.

Other potential applications might include plates of interest to specific units, such as the Gang Enforcement Unit or Domestic Violence Unit. In other words, if the ALPR vehicle was to be used to enhance other investigations, allowing the operator to manually enter vehicle license plates associated to that particular investigation would be helpful. Other plates that may be of interest to police would include vehicles associated with a violent crime within the past 24 hours; however, as the currently stated purpose of ALPR does not include responding to incidents of crime, the policy around ALPRs use would need to be amended prior to amending the policy regarding manually uploaded license plates. It is important to note that the database administrator can identify plates that were manually entered to confirm that they were entered appropriately (Denham, 2012). Thus, there is already policy in place to provide oversight to ensure the database is modified only in limited pre-approved circumstances.

RECOMMENDATION 8: PERIODICALLY REVIEW THE ACCURACY OF THE ALPR CAMERAS

The interviews with traffic members revealed a perception that the technology works quite well at reading plates. However, there is not a standard practice in place to actually review whether the technology is working well. Thus, one recommendation resulting from this study is that Surrey develop and implement a policy to ensure that the ALPR technology is regularly tested for accuracy.[16] Although the traffic members perceived that the technology worked well, a brief observation of the technology in action suggested that many misreads were not being detected because they were not resulting in a hit and, therefore, not coming to the attention of the member. It is not possible to determine without further investigation how many of these misread plates might have generated a hit if they had been read accurately. Thus, Surrey should consider implementing a periodic data quality audit where plate readings are observed for accuracy and the plate data manually entered to determine accuracy rates and the implications resulting from misread non-hit data.

Checking the accuracy rate can easily be done on a regular basis using civilian personnel, volunteers, or practicum students who can review the database of plate images taken by ALPR and compare each image to the plate number generated by the technology. Periodically engaging in a "one-day snapshot" where inaccurately read plates are compared to that day's hot list can provide some insight on how often inaccurately read data is resulting in the loss of a potential police action. Determining why the plates were read inaccurately, which could include unclear camera lenses, poor environmental conditions, commonly misread characters, different types of license plates, or circumvention devices (IACP, 2009; Roberts & Casanova, 2012), would also be helpful to understand both in terms of developing strategies to enhance accuracy of plate reads and in considerations for expanding the use of the technology. Further, the IACP (2009) noted that being aware of the type of mistakes made by a particular system's cameras can help investigators to run

[16] Some guidelines on this process can be found in Lyons, V. (2014). *Guidance on ANPR Performance Assessment and Optimisation*. Home Office, UK. https://www.gov.uk/government/organisations/home-office

queries on potentially misread license plate numbers. Information on the cause of the misread could also be collected during a regular review as those conducting the review could be trained to record the source of the misread.

RECOMMENDATION 9: FURTHER PROMOTE THE USE OF ALPR WITHIN THE SURREY RCMP DETACHMENT AND MAINTAIN THE PUBLIC'S AWARENESS OF ITS USE

Generally, members perceived that knowledge regarding the use of ALPR outside of traffic services was limited, both among the public and among other Surrey RCMP members. In 2009, the IACP weighed the benefits and drawbacks of informing the public about ALPR use. The benefits included generating a positive perception of being forthcoming with the public and potential deterrence of traffic safety violations, while the drawbacks included generating public concern regarding invasions of privacy and causing those violating traffic rules to avoid areas where ALPR cameras are likely to be present (IACP, 2009). Should an agency choose to make their use of ALPR public, ways of doing so range from posting information on their website to inviting public comment on information management policies (IACP, 2009).

Lum and colleagues (2010) surveyed a random sample of the public to determine their awareness of ALPR, its effect on perceptions of police legitimacy, and its potential deterrent effect. Their results indicated that although nearly two-thirds (63%) of the public had heard about the technology, few understood exactly how the police used it. When this was explained to the participants, only one-quarter (26%) reported that police use of ALPR would change their traffic related behaviour. Thus, promoting use of ALPR to the public for deterrence purposes is unlikely to achieve much success. Unless the Surrey RCMP wanted to engage in a strategy of promoting the "myth of full enforcement" in which the police publicly promote through the media their use of ALPR technology without specifically identifying how many cameras they have and where they are located to achieve some degree of deterrence to potential traffic safety violators, the current degree of public awareness regarding their use of ALPR is likely ideal.

That said, promoting the use of ALPR to the public for the purposes of disclosure could be beneficial, particularly if the RCMP chose to expand ALPR's current purpose. Lum and colleagues' (2010) study found that the vast majority of participants were supportive of police use of ALPR to detect stolen vehicles (80%) and to check for persons wanted by police (77%). Furthermore, one of the recommendations in the City's recent Crime Reduction Strategy is to use ALPR to detect offenders and priority crimes (http://www.surrey.ca/files/Crime_Reduction_Strategy.pdf). Thus, if Surrey wanted to expand its use of ALPR to detect known offenders, they would likely be able to obtain a good degree of public support.

Although unconfirmed among the general population of members, the interview data from the traffic services unit suggested that non-traffic members in Surrey are generally unaware that the traffic services unit uses ALPR. Thus, the Surrey RCMP may need to promote the use of ALPR amongst its non-traffic members, particularly if they are considering expanding its use for investigatory purposes. If other members are not aware that traffic services has access to an ALPR-equipped vehicle or, more likely, that they can apply to search the ALPR databases for information on a vehicle associated to a file they are working on, its potential to assist in investigations or

monitoring of high-risk offenders will be limited. Thus, it is recommended that some information on the potential application of ALPR beyond traffic services be provided at briefings so that special unit members (e.g. domestic violence, gang squad, property crime), general patrol members, and crime analysts can consider periodically borrowing this technology or accessing the information routinely collected by it to enhance their investigations.

RECOMMENDATION 10: IMPROVE DATA COLLECTION

Although ALPR data collection is generally quite good, there are two areas that should be improved. First, there must be greater consistency in recording information relating to where reads occur. X and Y coordinates that facilitates geocoding and, by extension, geographic analysis were missing for almost half (47.3%) of all reads in this study. As a result, the analysis of ALPR data by Surrey communities is necessarily tentative. As the reasons for the absence of location information are unclear, it is not possible to determine whether the missing data is random or systematic. This makes it difficult, for example, to identify "hot spots" or conduct other geographic analyses with any degree of certainty. The second area where missing data is problematic is dispositions. This shortcoming was particularly prominent in cases involving stolen vehicles, but it was noticeable across most of the other hot list categories. The prevalence of missing values suggests that more routine data analysis could assist in verifying that data collection was more complete.

Conclusion

The Surrey RCMP is one of several RCMP detachments in British Columbia currently operating ALPR technology. The study participants all agreed that ALPR enhanced their ability to police effectively. Specifically, ALPR substantially increased the number of license plates they were able to scan in a shift and detected both more and different types of hits than they would be able to do manually. The use of ALPR allowed them to focus on the right people and reduced the number of vehicles they were stopping who had not committed a traffic violation.

Unfortunately, the results of the data analysis and interview studies also demonstrated that ALPR is not being used in Surrey to its full potential. The vehicle is deployed much less frequently than it should be and its deployment is not usually done in a strategic, information, and intelligence led way. While some potential uses of ALPR are currently restricted by privacy regulations and the number of resources currently assigned to this unit, this report has identified several ways in which the use of ALPR can be improved in Surrey to increase its effectiveness and efficiency in contributing to public safety.

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Appendix A: Descriptive Statistics by Time of Day

	Reads	Hits	Hit Rate	Standardized Differential
0	2,600	58	2.23	1.42
1	844	15	1.78	1.16
2	159	4	2.52	2.58
3	147	3	2.04	1.79
4	49	2	4.08	5.21
5	48	1	2.08	1.89
6	892	9	1.01	-0.13
7	2,118	24	1.13	-0.27
8	4,962	64	1.29	-0.81
9	5,838	85	1.46	-0.78
10	6,101	105	1.72	-0.42
11	8,136	114	1.40	-1.52
12	7,878	123	1.56	-1.18
13	6,473	89	1.37	-1.10
14	8,530	144	1.69	-1.16
15	10,006	154	1.54	-1.82
16	12,451	170	1.37	-2.80
17	9,215	157	1.70	-1.32
18	5,544	96	1.73	-0.24
19	6,486	96	1.48	-0.93
20	4,850	78	1.61	-0.25
21	5,089	76	1.49	-0.51
22	3,842	68	1.77	0.30
23	1,934	35	1.81	0.91
Total	114,192	1770	1.55	

Appendix B: Descriptive Statistics by Day of the Week

	Reads	Hits	Hit Rate	Standardized Differential
Sunday	20,127	326	1.62	-0.59
Monday	14,785	263	1.78	1.86
Tuesday	10,224	177	1.73	2.68
Wednesday	13,633	201	1.47	0.05
Thursday	21,655	312	1.44	-2.21
Friday	18,308	261	1.43	-1.47
Saturday	15,460	230	1.49	-0.32
Total	114,192	1770	1.55	

Appendix C: Descriptive Statistics by Month

	Reads	Hits	Hit Rate	Standardized Differential
January	9,179	105	1.14	-0.93
February	12,590	226	1.80	-0.28
March	3,774	52	1.38	0.44
April	8,804	171	1.94	0.65
May	3,470	42	1.21	0.17
June	14,538	211	1.45	-1.26
July	17,404	224	1.29	-2.06
August	16,166	254	1.57	-1.31
September	17,314	229	1.32	-1.98
October	3,696	111	3.00	3.54
November	4,546	100	2.20	1.87
December	2,711	45	1.66	1.16
Total	114,192	1,770	1.55	

Appendix D: Dispositions – Original Categories

Disposition	Category	n = 1,826	%
Not Stopped		1,034	56.6
Parked Unoccupied		223	12.2
No Charge Action	Registered Owner Not Driving	142	7.8
	Valid Driver's License	84	4.6
	Outstanding Warrant	4	0.2
	Serve Notice of Prohibition	2	0.1
	No Case Drug Seizure	1	0.1
	Immediate Roadside Prohibition	1	0.1
Provincial Charge	No Driver's License	47	2.6
	No Insurance	16	0.9
	Driving While Prohibited	9	0.5
	Driving Contrary to Restrictions	5	0.3
	No 'L' or 'N'	3	0.2
	Other	2	0.1
Criminal Code	Driving While Prohibited	1	0.1
	Other	1	0.1
Missing		251	13.7

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