



Transport
for NSW

ANNUAL NSW SPEED CAMERA PERFORMANCE REVIEW

NSW Centre for Road Safety

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Executive summary

The purpose of the *Annual NSW Speed Camera Performance Review* is to provide a systematic process for monitoring the effectiveness of speed cameras in NSW to ensure they are having a positive road safety effect. This report summarises the analysis undertaken by the NSW Centre for Road Safety (CRS) for the annual speed camera review against criteria outlined in the *NSW Speed Camera Strategy 2012*.

This report addresses the recommendation from the 2011 NSW Auditor-General's audit of speed cameras,¹ to provide the community with information about the road safety impact of speed cameras. Where it is determined a camera has not been effective, alternative road safety countermeasures will be considered. The findings from this annual review will guide the planning of future speed enforcement priorities and operations.

This report also addresses the NRMA Motoring & Services' recommendation for an assessment of all high infringing speed camera locations across NSW.

Evaluation

The evaluation criteria for each camera type outlined in the Strategy has been determined by CRS based on the road safety benefit that is expected to be achieved from each program. Broadly speaking camera effectiveness is measured by two key criteria:

- the reduction in crashes and casualties, caused by the speed camera slowing drivers down, and
- the reduction in infringement rates, caused by the speed camera slowing drivers down.

Typically at least five years of crash and casualty data are required to make an assessment of a camera's effectiveness. The red-light speed camera and point-to-point enforcement programs are in their early stages, with most locations only operational for three years or less. Given the infancy of these programs, the data analysed in this annual review will not be sufficient to assess reliably the effectiveness of individual camera locations. Due to the mobility of mobile speed cameras and their purpose of creating a general deterrence effect across the road network, the analysis examined crash data for the entire state, not individual mobile speed camera locations.

Key findings

Table 1: Key findings for NSW speed camera programs

Camera type	Size of NSW program as at 31 December 2013	Program effectiveness
Mobile	640 locations Approximately 930 hours of enforcement per month	<p>Overall, the trend in road fatalities and annual speed surveys demonstrates that the mobile speed camera program continues to deliver positive road safety benefits, compared with results prior to the reintroduction of the mobile speed camera program in 2010.</p> <p><u>Road Toll</u></p> <ul style="list-style-type: none"> • The provisional 2013 road toll of 339 fatalities on NSW roads is the lowest annual figure since 1924 (with 309 fatalities). This is also 25 per cent lower than in 2009 (with 453 fatalities), before the reintroduction of the mobile speed camera in 2010. <p><u>Speed Survey</u></p> <ul style="list-style-type: none"> • Results from the 2013 speed surveys show speeding continues to remain below the level observed in 2009, prior to the reintroduction of the mobile speed camera program in 2010. The percentage of light vehicles exceeding the speed limit by up to 10km/h in 2013 was lower when comparing 2013 results to those from 2009 to 2011. The comparisons of the 2013 results with the 2012 results were more mixed, with further reductions in most speed zones, but slight increases in some

¹ Audit Office of NSW (2011). *Improving Road Safety: Speed Cameras*. New South Wales Auditor-General's Performance Audit Report

Camera type	Size of NSW program as at 31 December 2013	Program effectiveness
		<p>zones.</p> <ul style="list-style-type: none"> The percentage of light vehicles exceeding the speed limit by more than 10km/h in 2013 reduced compared to 2012 in most speed zones, with the exception of speeding in 50km/h and 70km/h zones. The results for light vehicles exceeding the speed limit by more than 10km/h, with the exception of speeding in 90km/h zones, were lower than the 2009 results, before the mobile speed camera program was reintroduced in 2010. Significant gains were achieved in reducing heavy vehicles exceeding the speed limit by more than 10 km/h, with the lowest percentages achieved over the entire five year review period in most zones. <p><u>Mobile Speed Camera</u></p> <ul style="list-style-type: none"> Operating on the same program capacity as 2012, a total of 13,766 infringements were issued from mobile speed camera enforcement in 2013. Over 99 per cent of vehicles passing mobile speed cameras are not infringed for speeding. This high rate of compliance has remained consistent since 2010 when the program was reintroduced.
Red-light speed	144 cameras at 125 intersections	<p>Preliminary analysis of the red-light speed camera program show encouraging results in changing driver behaviour at signalised intersections with red-light speed camera enforcement.</p> <p>Overall, when comparing the five years before red-light speed cameras were installed to the post installation period for each camera location there has been:</p> <ul style="list-style-type: none"> a 24 per cent reduction in crashes; a 49 per cent reduction in pedestrian casualties; and a 36 per cent reduction in all casualties at these locations. <p>This reduction in casualties represents a saving of \$70.3 million to the community.</p> <p>The top 10 highest infringing red-light speed cameras all had high compliance rates with more than 99 per cent of drivers passing the cameras without being infringed for red-light running and or speeding. Where cameras have been operating for longer than two years, infringements had mostly decreased over time.</p>
Fixed	132 cameras at 107 locations*	<p>Overall, when comparing the five years before the fixed speed cameras were installed to the most recent five years there has been:</p> <ul style="list-style-type: none"> a 42 per cent reduction in the number of crashes; a 90 per cent reduction in fatalities; and a 40 per cent reduction in injuries at these camera locations. <p>These reductions in casualties represent a saving of \$445.74 million to the community.</p> <p>Of the 95* fixed speed camera locations that were reviewed, 93 were found to be effective. The remaining two were identified for further review, these are:</p> <ul style="list-style-type: none"> Richmond Road, Berkshire Park Great Western Highway, Hartley

Camera type	Size of NSW program as at 31 December 2013	Program effectiveness
		The 10 highest infringing fixed speed cameras were all found to be effective in reducing crashes and casualties. All had high compliance rates with more than 99 per cent of drivers passing the cameras without being infringed for speeding.
Point-to-point	21 lengths	Preliminary analysis of point-to-point enforcement lengths shows that there has been a low number of heavy vehicle crashes since camera operation. Infringement data for average speed offences in point-to-point enforcement lengths show a high level of compliance and a low number of infringements.

* Of the 107 fixed speed camera locations, seven locations operate in warning mode and five locations are 'high risk' locations (typically located in tunnels). These locations were not included in the fixed speed camera analysis.

The NSW Centre for Road Safety will continue to annually review all individual speed cameras as well as the overall performance of speed camera programs as set out in the *NSW Speed Camera Strategy 2012*. These reviews will be published annually to ensure that the programs remain transparent to the community.

Introduction

In response to the Auditor-General's recommendation the NSW Government announced the *NSW Speed Camera Strategy* on 1 June 2012. The strategy provides an integrated framework for speed enforcement in NSW and aims to improve the transparency and understanding of the use of speed cameras in NSW through increased community engagement and education. The strategy was developed in consultation with the NSW Police Force and NRMA Motoring and Services, and reinforces the Government's commitment to reducing fatalities and serious injuries on NSW roads.

One of the key actions outlined in the *NSW Speed Camera Strategy* is the annual publication of camera performance against criteria outlined in the Strategy. This action also meets the NSW Auditor-General's recommendation to provide the community with information about the road safety impact of speed cameras.

The purpose of the *Annual NSW Speed Camera Performance Review* is to present the results of performance evaluations carried out on each of the speed camera programs in NSW. The Auditor-General found that the right speed camera in the right place can save lives. Cameras not delivering the expected road safety benefits will be monitored and evaluated and if considered not effective will be removed and perhaps relocated. The findings from this report will guide the planning of future speed enforcement operations.

The speeding problem

Speeding, which encompasses excessive speed (driving above the speed limit) or inappropriate speed (driving too fast for the prevailing conditions), is unquestionably recognised as a major contributing factor in both the number and severity of traffic crashes in NSW.

Speeding increases the risk of having a crash, and increases the risk of serious injury or death in the event of a crash. Studies of survival and impact speed show that small increases in travel speed can result in large increases in braking distances and impact speed, resulting in both an increased risk of a crash and a more severe outcome. This is especially the case for crashes with less protected road users such as pedestrians and cyclists.

Effectiveness of camera enforcement

Speed camera enforcement is an important road safety initiative that has proven road safety benefits and is a commonly employed method of speed enforcement in many best practice road safety jurisdictions throughout the world. Speed enforcement helps to reduce the proportion of drivers who exceed the speed limit on our roads, which in turn reduces the risk of being involved in a fatal or injury crash and the severity of outcomes in the event of a crash.

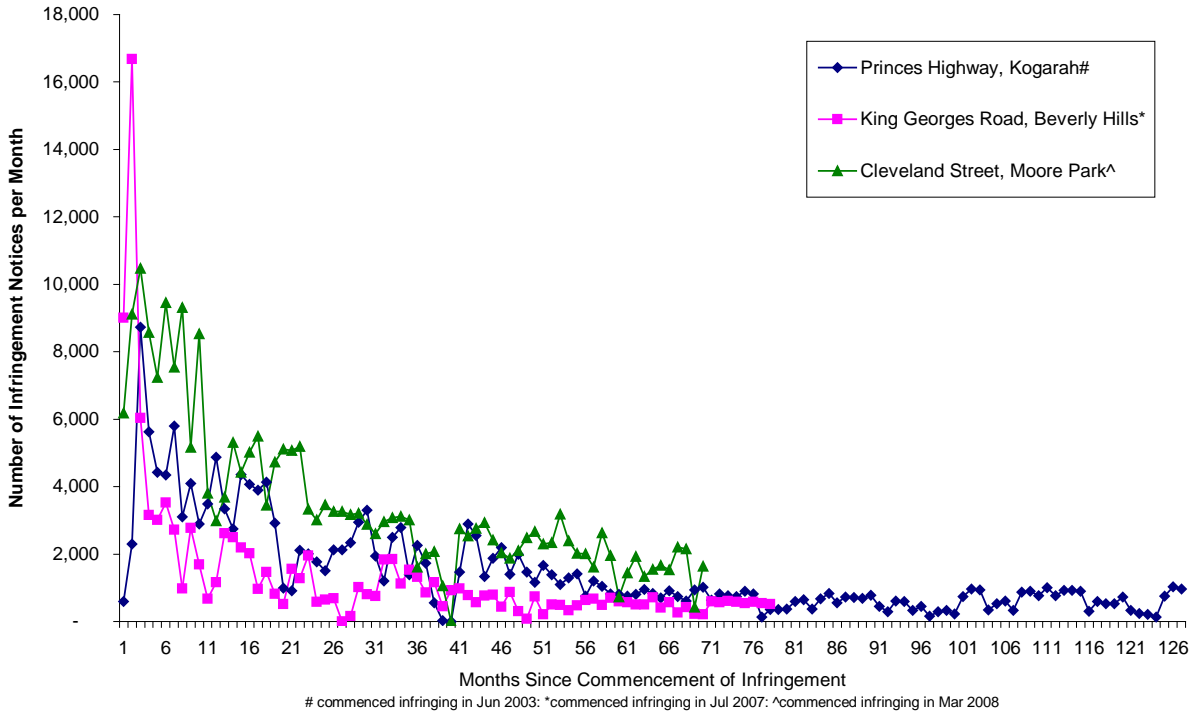
Speed enforcement activities aim to increase the perceived threat of being caught speeding and in doing so help to reduce the mean travel speed on our roads, and therefore reducing the risk of being involved in a fatal or injury crash for all road users. Automated camera enforcement supplements enforcement conducted by police and can also operate in locations that are difficult for police to enforce. The NSW Police Force routinely requests locations to be considered for automated speed enforcement.

Changing driver behaviour

Speed cameras are used to change driver behaviour, which can be measured by changes in infringements over time. An example of this trend is illustrated in Figure 1 that depicts the number of infringements per month since the commencement of enforcement at three of the highest infringing fixed speed camera locations. This pattern shows an initial high number of infringements followed by a rapid and sustained decrease in infringements as drivers modify their behaviour which is reflected in a reduction in crashes over time. Appendix C contains this type of infringement graph for every fixed speed camera location.

Figure 1: Example of trend in speed camera infringements over time.

Number of Fixed Speed Camera Infringement Notices per Month for Sample of Cameras



Speed camera programs in NSW

Speed cameras are speed enforcement tools that supplement enforcement conducted by the NSW Police Force. They have been proven to make roads safer by reducing speeding and in turn the number and severity of crashes. Table 1 shows the four types of speed cameras used in NSW.

Table 2: Types of speed camera enforcement in NSW

Speed cameras used in NSW			
Type	Main purpose	Introduced	Size of NSW program as at 31 December 2013
Mobile	General network deterrence	First introduced in 1991. Ceased operation in December 2008 and re-introduced in 2010	640 locations Approx 930 hours of enforcement per month
Red-light Speed	Location specific (To address high risk intersections)	2009	144 cameras at 125 intersections
Fixed	Location specific (To address black spot/high risk)	1997	132 cameras at 107 locations*
Point-to-Point	Route enforcement (For heavy vehicles only)	2010	21 lengths

* Of the 107 fixed speed camera locations, seven locations operate in warning mode and five locations are 'high risk' locations (typically located in tunnels). These locations were not included in the fixed speed camera analysis.

Mobile speed cameras

Mobile speed cameras produce a sustained change in driver behaviour by creating a perception that speeding can be enforced anywhere at any time. Therefore they reduce speeding not only at identified enforcement locations but also spread the deterrence effect of cameras across more of the road network. This is because drivers are less able to predict where enforcement will occur; the less predictable the enforcement, the more broadly speed limit compliance can be achieved and the greater the crash problem that is addressed. Mobile speed cameras can be moved around the road network at various times and locations.

Red-light speed cameras

Red-light speed cameras are location-specific as they address speeding and red-light running at signalised intersections where drivers are vulnerable to right angle crashes and there is an elevated risk of a pedestrian crash. Both of these crash types can result in severe injuries even in lower speed crashes.

The NSW Police Force previously managed red-light cameras at 183 intersections across the Sydney, Newcastle and Wollongong metropolitan areas. These cameras were becoming outdated and used obsolete wet-film technology and the program was handed over to the former Roads and Traffic Authority in December 2008. The newer red-light speed cameras, which use digital technology, were introduced in late 2009 to replace some of these wet-film locations as well as enforce new intersections.

Fixed speed cameras

Fixed speed cameras are located at specified road lengths where there is a high crash risk or a demonstrated crash history.

In early 2011 there were 172 cameras operating at 141 locations. When the audit of speed cameras was released in July 2011, the Minister for Roads and Freight directed the deactivation of fixed speed cameras that were found to not be delivering the expected road safety benefit at 38 locations. Safety reviews have now been conducted at these locations and camera infrastructure has since been removed from 11 of these locations. A program of alternative safety works has commenced at the remaining locations. When these alternative safety works have been completed, the speed camera and signage will

be removed. Cameras at seven of these locations remain in warning mode following safety concerns expressed by the community.

An additional two fixed speed cameras were also approved for decommissioning at Cowpasture Road, Green Valley and New England Highway, Kootingal following the 2012 Annual NSW Speed Camera Performance Review. Cowpasture Road was upgraded in December 2010 from a two lane road to a four lane divided carriageway with traffic signals at key intersections. Since the upgrade, the crash rate at this location has reduced, as has the severity of crashes. The camera at Cowpasture Road, Green Valley was removed in 2013. Similarly, at the New England Highway, Kootingal location the safety review found a very low number of crashes and minimal ongoing road safety concerns, and recommended that the speed camera could be better used at another high risk location on the road network. When alternative safety works have been completed at this location, the speed camera and signage will be removed.

In 2012, the speed camera located at the M2 Tunnel (M2 Motorway) was also decommissioned due to the completion of major road works that improved road safety at the location and the relatively short length of the tunnel.

Following the results of the 2013 Annual NSW Speed Camera Performance Review, five locations were identified for comprehensive review based on the crash data analysis. These locations were: Hume Highway, Ashfield (school zone); Hume Highway, Bankstown (school zone); Fairfield Street, Fairfield East; McCaffrey Drive, Rankin Park; and Pacific Highway, Sandgate.

Reviews of these five fixed speed camera locations were completed in December 2013. The review team, led by an independent road safety auditor included CRS, councils, nearby schools, NRMA Motoring and Services, the NSW Police Force and local communities. The review recommended that the two speed cameras at Pacific Highway, Sandgate be decommissioned while cameras at the remaining four locations be retained as they continue to provide road safety benefits.

At Pacific Highway, Sandgate, the safety review found that while the number of speeding infringements had consistently reduced at this location, the number of injury crashes and the number of injuries had increased. The review found that the two speed cameras at this location were not performing their required function and recommended they be removed. These cameras will be removed once a program of road safety works is implemented.

Point-to-point enforcement

Point-to-point enforcement addresses speeding along travel routes with a demonstrated history of crashes. Point-to-point enforcement in NSW targets heavy vehicles as they are over-represented in crashes on known heavy vehicle routes. Point-to-point enforcement works by measuring the amount of time it takes a heavy vehicle to travel between two points and then calculating the average speed of the vehicle. If the vehicle's average speed is faster than the speed limit for the length of road, the driver will be infringed for speeding.

Evaluation criteria

The ultimate indicator of performance for all speed cameras in NSW is a reduction in people killed and injured in crashes. The following tables outline the criteria that have guided the evaluation of speed cameras in NSW as well as the overall effectiveness of the *NSW Speed Camera Strategy*.

Table 3: Criteria for measuring camera effectiveness

Enforcement type	Evaluation data	Measure of effectiveness
Mobile speed cameras	Annual speed surveys	Reduction in vehicles exceeding speed limit across the road network/ random sample of locations
	Compliance data	Increase in compliance rates/Reduction in infringement rates
	Crash data	Reduction in crashes and casualties across NSW
Red-light speed cameras	Speeds	Reduction in vehicles exceeding speed limit at intersection
	Compliance data	Increase in compliance at intersection/Reduction in infringement rates
	Crash data	Reduction in casualties and crashes at intersection
Fixed speed cameras	Speeds	Reduction in vehicles speeding within 500 metres of the camera
	Compliance data	Increase in compliance at camera location/Reduction in infringement rates
	Crash data	Reduction in casualties and crashes within 500 metres of the camera
	Risk	Level of risk continues to be reduced at the location (for example low level of speeding and/or crashes in tunnels)
Point-to-Point enforcement	Speeds	Reduction in heavy vehicle speeding within enforcement length
	Compliance data	Increase in compliance within the enforcement length/Reduction in infringement rates
	Crash data	Reduction in crashes within enforcement length

Table 4: Criteria for measuring overall effectiveness of enforcement programs

Program	Outcome
Mobile speed camera	Reduction in road trauma, speed-related crashes and speeding across the entire road network
Red-light speed camera	Reduction in frequency and severity of crashes at enforced intersections (and at all signalised intersections due to deterrent effect across the network)
Fixed speed	Reduction in vehicles speeding and the frequency or severity of crashes at fixed speed camera locations
Point-to-Point	Reduction in speeding and the frequency and severity of crashes on point-to-point enforcement lengths

Evaluation method

2013 Road toll data

The crash data used in this annual review include crashes which occurred between 1 January 2013 and 31 December 2013. It is important to note that this is still preliminary data. Annual road toll statistics are not finalised until approximately nine months after the end of the calendar year. This is because of the time lag involved with the receipt of late reports and the processing of exclusions arising from Coronial inquiry determinations.

The crash statistics recorded by Transport for NSW and included in this annual review are confined to those crashes which conform to the national guidelines for reporting and classifying road vehicle crashes² and are based on the following criteria:

1. The crash was reported to the Police
2. The crash occurred on a road open to the public
3. The crash involved at least one moving road vehicle
4. The crash involved at least one person being killed or injured or at least one motor vehicle being towed away.

Speed camera crash data

Crash data have been examined at individual speed camera locations for fixed, red-light speed and point-to-point cameras to ascertain performance at camera locations. For mobile speed cameras, the annual review examined crash data for the entire state rather than individual locations due to the mobility of mobile speed cameras and their purpose of creating a general deterrence effect across the road network.

Typically at least five years of crash and casualty data are required to make an assessment of a camera's effectiveness.³ Since the red-light speed camera and point-to-point enforcement programs have been operational for less than four years, the data provided in the annual review were not sufficient to reliably assess the effectiveness of individual camera locations and only preliminary observations are made.

Crash data results for injuries for the six quarters from July 2010 to the end of 2011 were over estimated due to a coding practice change in the injury recording process. The coding practice change resulted in an over enumeration of around nine per cent for this period, mostly amongst vehicle occupants, and may influence the results of casualties and injuries for the evaluation period across the speed camera programs. Where a camera appears to not be performing, CRS will review the crash data to determine if the camera has been affected by the coding practice change.

Red-light speed cameras

Preliminary analysis of the red-light speed camera program has been conducted by intersection, rather than by camera. At the end of 2013, there was a total of 144 red-light speed cameras operating at 125 intersections around Sydney, Newcastle and Wollongong with 18 intersections having two or more cameras.

Crash data were examined at each intersection with a red-light speed camera for all crashes that occurred within 10 metres of the intersection. The analysis provides crash data for the five year pre installation period, ending 91 days before the commencement date (as this is the period in which the camera was under construction). The post installation period is from the commencement date to the end of 2013. Red-light speed cameras operate in warning mode for a period prior to issuing infringements.

In addition to total casualties at each location, pedestrian casualties have also been specifically examined given the greater exposure of pedestrians at signalised intersections and the higher likelihood of severe casualty outcomes for this group due to their lack of protection in a crash. Data is also provided for adjacent, right through and rear-end crashes before and after camera installation as these

² More information about how crash data is processed in NSW is available online at www.roadsafety.transport.nsw.gov.au.

³ Austroads (2009). *Guide to Road Safety Part 8: Treatment of Crash Locations*. Publication No. AGRS08/09.

are the crash types that typically occur at intersections. Adjacent and right-through crashes are often more severe as drivers and passengers are not as protected from side impact crashes, with low-speed side impact crashes potentially resulting in severe injuries. The frequency and severity of these crash types are expected to reduce at intersections enforced by red-light speed cameras. Rear-end crashes are included in the preliminary analysis as it has been reported that red-light cameras can lead to an increase in rear-end crashes due to drivers suddenly stopping on an amber light.⁴ It is expected that the simultaneous enforcement of speeding by these red-light cameras will reduce the likelihood of an increase in rear-end crashes.

Additional technical notes for the analysis of red-light speed cameras:

1. Crashes are assigned to the traffic signal controlled intersections enforced. An intersection crash is one which occurs within, or up to 10 metres from an intersection. Initially crashes geo-coded as within 90 metres of the Traffic Control System (TCS) feature and that occurred at the intersection were selected.
2. These were viewed and attributed to the intersection under analysis taking into account the geo-coding as well as the values in the street name, the ID feature, and the intersection-type fields
3. Where unclear, the correct location of the crash was confirmed or inferred from the original police report.
4. The commencement of the warning letter period is listed for each camera. For the analysis of intersections with two cameras, the post installation period began with the earlier commencement date.
5. Data for each crash type (adjacent, right- and rear-end) was reported based on Road User Movement (RUM) codes. RUM codes describe the first impact that occurred during the crash. Adjacent crashes are indicated by RUM code 10; Right-crashes are coded 21 and rear-end crashes are coded 30. More information on RUM codes can be found in the Annual Statistical Statement at http://roadsafety.transport.nsw.gov.au/downloads/accident_statistics_dl4.html
6. The improvement rates for crashes and casualties are based on the annual averages in crashes and casualties at each location before and after the cameras were installed. This allows an approximate comparison to be made between the five year pre installation period and the available data for the post installation period until December 2013 (currently less than five years for all red-light speed camera locations).
7. Data for the crash analysis have not been ranked and are presented alphabetically by suburb of the camera location.

Fixed speed cameras

Analysis of the fixed speed camera program has been conducted by fixed speed camera location, rather than by camera. While there are currently 107 fixed speed camera locations across NSW, 95 fixed speed camera locations were analysed in this report. Of the 107 locations, seven locations operate in warning mode following the 2011 audit of speed camera programs. These cameras are not evaluated as part of this report, however they will continue to be monitored and information on crashes and infringements at these locations is available at Appendix D. A further five locations were not assessed for their individual effectiveness because they are located in tunnels and no pre-installation data are available, however crash and infringement data for these locations is included in Appendix C. One location, the M1 Princes Motorway (formerly the F6, Southern Freeway) Gwynneville, has two cameras operating approximately 1,000 metres apart and infringing in different directions, therefore these cameras were analysed as separate locations in the directions they enforce.

For each of the 95 locations included in the analysis, typically crash data within 500 metres either side of the fixed speed camera was examined. For cameras located within a school zone, crash data was examined from patch-to-patch (i.e. the length of road designated as a school zone, as identified by the start and end patches marked on the road). For locations with more than one camera in operation (where cameras are less than 100 metres apart), the crash analysis length was for 500 metres either side of the mid-point of the two cameras.

Fixed speed camera performance was measured through an evaluation of pre and post installation crash data. In most cases, the analysis provides crash data for the five year pre installation period, ending

⁴Budd, L., Scully, J. & Newstead, S.. (2011). *Evaluation of the Crash Effects of Victoria's Fixed Digital Speed and Red-light Cameras*, Report No. 307, Monash University Accident Research Centre., Publicly available from: <http://www.monash.edu.au/miri/research/reports/muarc307.pdf>.

three months directly before the commencement date (as this is the period in which warning letters are issued). The post installation period is the most recent five calendar year period (2009 - 2013) to assess the current performance of the speed camera.

For the seven locations operating in warning mode, crash and infringement results are provided from July 2012 until the end of the review period. These cameras began operating in warning mode at different times, starting from August 2011. By July 2012, cameras at all seven locations commenced operating under a 'three strike' scheme where vehicle owners receive an infringement notice on the third speeding offence at any of the seven locations. Vehicles detected speeding more than 30km/h over the speed limit receive a court attendance notice and face significant penalties.

For each of the five 'high risk' camera locations, crash data has been reported for the 2013 calendar year only as there is no pre-installation data for analysis (typically tunnel locations).

Based on the pre and post installation crash analysis, and along with other relevant site specific information, the report lists a recommendation for each fixed speed camera location. The camera location is listed as either:

- a) Effective (delivering the expected road safety benefits); or
- b) Recommended for review.

Fixed speed camera locations have been classified as being effective and delivering the expected road safety benefits if the current crash analysis satisfies any one of the following criteria:

1. There is a lower number of total casualties and the same or lower number of crashes in the after period compared to the before period, and no fatalities in the after period.
2. There is the same number of total casualties but a lower number of total crashes in the after period compared to the before period, and no fatalities in the after period.
3. If there was at least one fatality in the before or after period, the combined cost to the community of fatalities and injuries in the after period is less than the combined cost in the before period. This acknowledges the greater cost to the community of fatalities compared to injuries. The estimated cost of road crash casualties is calculated using the willingness to pay methodology, which reflects the accumulated value the NSW community is willing to pay or forgo in exchange for a reduction in the probability of crash related injuries and road crash deaths on NSW roads. According to willingness to pay, casualty costs are \$6.465 million per fatality, and \$0.115 million per injury.⁵
4. Fixed speed cameras have been installed in tunnels and other areas under the 'high risk' site selection criteria. For these locations, there are no available data in the before period due to there being no crash history prior to camera implementation. However, any crash that occurs in these areas would have potentially catastrophic consequences due to difficulties of access by ambulance and emergency vehicles to the crash site.

Fixed speed camera locations have been identified for review if the current crash analysis satisfies any one of the following criteria:

1. There is a higher number of total casualties and total crashes in the after period compared to the before period.
2. There is a higher number of total casualties in the after period compared to the before period, and the same number of total crashes in both before and after periods.
3. There is a higher number of total casualties but a lower number of total crashes in the after period compared to the before period, and no fatalities in the after period.
4. There is a slightly lower number of total casualties but a higher number of total crashes in the after period compared to the before period, and no fatalities in the after period.
5. There is the same number of total casualties, and the same number of total crashes, in both before and after periods (and no fatalities in the after period).

⁵ Transport for NSW Principle and Guidelines for Economic Appraisal of Transport Investment and Initiatives, 2013

6. If there was at least one fatality in the after period, the combined cost to the community of fatalities and injuries in the after period is greater than the combined cost in the before period. This acknowledges the greater cost to the community of fatalities compared to injuries (with calculations based on the willingness to pay methodology, as already outlined).
7. Major road works such as curve re-alignment or highway duplication have significantly improved safety at the existing location.

Where a fixed speed camera location satisfied any of these criteria, a further desktop review of the location was conducted, to determine the appropriateness of the recommendation. This analysis considered the trend in casualty crashes, the circumstances of fatal crashes at the location and the specific types of crashes that occurred at the location. Where there was additional information which indicated the camera was delivering a road safety benefit, this is indicated in the report and the camera is classified as being effective.

Additional technical notes for the analysis of fixed speed cameras:

1. The commencement date listed for each location refers to the month and year that the fixed speed camera commenced infringement at that location. For locations where more than one fixed speed camera is in operation, the date listed refers to the month and year that the *first camera* started infringing at that location unless specified otherwise.
2. For each location, the pre and post installation periods vary depending on the date the camera commenced infringement, and excluded the three month period directly before the commencement date. For each location, the pre installation period was defined as the five year period up to three months prior to the commencement date of camera infringements. The post installation period was defined as the most recent five year calendar period.
3. In instances where there was less than five years post installation data, the five year pre installation data was adjusted so that it reflected an average number of crashes and casualties over an equivalent time period (e.g. four years). The post installation period was calculated as the time from when the camera began infringing to the end of 2013 (i.e. four years and 338 days). Analysis of some recently installed school zone locations was necessarily based on shorter post installation time periods.
4. In instances when there was less than five years of pre installation data, the pre installation period was adjusted so that it represented an equivalent five year period.
5. The percentage reduction for crashes and casualties are based on the annual averages in crashes and casualties at each location before and after the cameras were installed. This allows an approximate comparison to be made between the five year pre installation period and the most recent five calendar year post installation period (2009 - 2013).
6. Data for the crash analysis have not been ranked and are presented alphabetically on the location description of the camera location.

Point-to-point enforcement

At the end of 2013, there 21 point-to-point enforcement lengths: two lengths were installed in 2010; 13 lengths were installed in 2011; four lengths were installed in 2012; and two lengths were installed in 2013. The remaining four point-to-point lengths will be rolled out in 2014. There are eight lengths that have enforced for the entire 2012 - 2013 review periods; however this has still been for a period of three years or less and is too early to assess the effectiveness of individual enforcement lengths.

The current report provides heavy vehicle crash data for the five year period prior to the length commencing enforcement and available data for the period after the length was activated in warning period.

Speed survey data

Vehicle speeds are assessed state-wide through annual speed surveys undertaken by CRS at the same locations every year. These speed surveys are conducted across NSW on a range of roads with a range of speed limits to gather current information about speeding behaviour of both light vehicles and heavy vehicles. In 2013 annual speed surveys were conducted at 175 locations across NSW.

The annual speed surveys measure free travel speeds, with a headway of four seconds. That is, only the speeds of vehicles that are unimpeded by other traffic are measured. Therefore the survey provides a measure of the speed that drivers choose to travel rather than a measure of traffic congestion.

Speed surveys are not undertaken at specific speed camera enforcement locations, therefore at camera locations infringement data is used as a proxy for speed data in this review. Speed surveys are undertaken at a sample of speed camera enforcement locations so that speeding behaviour can be assessed for these programs.

Infringement data

All fines from speed cameras are directed to the Community Road Safety Fund to pay for all road safety programs across the state.

Recent infringement data were used as a proxy measure of speeding behaviour at camera locations. Infringement data analysed in this report includes penalty notices detected by Roads and Maritime Services speed cameras from July 2002 onwards (no infringement data is available prior to this date). Infringement data for red-light speed cameras, fixed speed cameras and mobile speed cameras are publicly available through the NSW Office of State Revenue (<http://www.osr.nsw.gov.au/info/statistics>).

Results and discussion

This review has found that across the four programs, speed cameras are continuing to improve road safety in NSW. Early results from the red-light speed, mobile speed and point-to-point camera programs show that drivers are changing their behaviour, which overall is resulting in a reduction in crashes and casualties at camera locations and across the road network. However, with less than five years of operation, it is still too early to assess the longer term effectiveness of these new programs. These programs will require ongoing monitoring of their performance by CRS into the future.

Key findings

Mobile speed cameras

The analysis of the mobile speed camera program is available at **Appendix A**.

In August 2011, a review of the NSW mobile speed camera program found that in the first year of operation (19 July 2010 to 18 July 2011) the program contributed to a 19 per cent statistically significant reduction in fatalities throughout NSW. This represents a saving of 89 lives and an estimated community saving of around \$575 million.

The immediate impact of the reintroduced mobile speed cameras is evident. The significant reduction in fatalities (and speed-related fatalities) in 2010, the first year of the program, can be attributed to the effect of enforcement as well as the deterrence effect, which produced broader speed limit compliance due to the less predictable enforcement of mobile speed cameras.

The ongoing impact of the mobile speed camera program is reflected in the provisional 2013 road toll. The provisional 2013 road toll is 339 persons killed on NSW roads. This result is the lowest annual figure since 1924 (with 309 fatalities). This is also 25 per cent lower than in 2009 (with 453 fatalities), before the reintroduction of the mobile speed camera in 2010. Speed-related crashes over 2009 to 2013 have also gradually decreased over this period.

Results from the 2013 speed surveys show speeding continues to remain below the level observed in 2009, prior to the reintroduction of the mobile speed camera program in 2010. The percentage of light vehicles exceeding the speed limit by up to 10km/h in 2013 was lower when comparing 2013 results to those from 2009 to 2011. The comparisons of the 2013 results with the 2012 results were more mixed, with further reductions in most speed zones, but slight increases in some zones.

The percentage of light vehicles exceeding the speed limit by more than 10km/h in 2013 reduced compared to 2012 in most speed zones, with the exception of speeding in 50km/h and 70km/h zones. The results for light vehicles exceeding the speed limit by more than 10km/h, with the exception of speeding in 90km/h zones, were lower than the 2009 results, before the mobile speed camera program was reintroduced in 2010.

Percentage of light vehicles exceeding the speed limit, 2009-2013

Posted Speed Limit	Light Vehicles Exceeding the Speed Limit – by up to 10 km/h					Light Vehicles Exceeding the Speed Limit +10 km/h				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
40 km/h School Zone	46.4%	44.0%	45.1%	42.0%	43.4%	23.0%	17.5%	19.7%	18.4%	17%
40 km/h	30.2%	27.8%	27.2%	32.0%	26.6%	4.5%	3.4%	3.7%	6.0%	3.4%
50 km/h	48.8%	46.4%	46.6%	42.8%	43.3%	16.8%	12.6%	13.2%	13.0%	14.1%
60 km/h	32.3%	28.8%	28.2%	29.9%	25.9%	7.3%	5.4%	5.8%	7.8%	6.3%
70 km/h	35.9%	31.3%	30.2%	28.2%	29.5%	10.4%	6.6%	6.3%	7.3%	8.2%
80 km/h	29.8%	26.3%	26.1%	24.8%	21.1%	8.8%	6.3%	6.6%	7.1%	6.2%
90 km/h – small sample [^]	29.6%	38.0%	38.5%	22.9%	24.8%	9.0%	11.8%	13.4%	10.0%	10.1%
100 km/h	34.5%	32.2%	34.4%	31.0%	27.6%	8.2%	9.0%	8.9%	9.4%	7.9%
110 km/h	40.8%	37.5%	38.9%	41.2%	33.9%	9.3%	6.4%	7.0%	11.4%	6%

[^] Small samples may result in greater fluctuations year to year.

*Note Heavy vehicle speed limit is 100 km/h and results presented indicate the percentage of heavy vehicles exceeding 100km/h in this section.

The percentage of heavy vehicles exceeding the speed limit by up to 10km/h has overall reduced compared to the previous year. Significant gains were achieved in reducing heavy vehicles exceeding the speed limit by more than 10 km/h, achieving the lowest percentages over the entire five year period in 40km/h school zones, 50km/h, 80km/h, 100km/h and 110km/h zones. Heavy vehicles continue to have lower proportions exceeding the speed limit than light vehicles.

Percentage of heavy vehicles exceeding the speed limit, 2009-2013

Posted Speed Limit	Heavy Vehicles Exceeding the Speed Limit – by up to 10 km/h					Heavy Vehicles Exceeding the Speed Limit + 10 km/h				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
40 km/h School Zone	42.2%	36.2%	43.3%	39.5%	39.7%	10.1%	10.2%	12.6%	8.1%	2.6%
40 km/h	26.6%	22.8%	21.0%	29.9%	21%	5.4%	3.6%	3.0%	6.2%	7.1%
50 km/h	45.6%	44.7%	42.5%	40.4%	38.3%	16.7%	12.5%	10.7%	10.0%	7.8%
60 km/h	26.7%	25.8%	25.4%	25.4%	22.7%	5.0%	3.9%	4.5%	9.6%	4.1%
70 km/h	28.6%	27.3%	23.7%	21.4%	24.1%	5.7%	4.2%	3.5%	3.6%	3.9%
80 km/h	23.6%	21.2%	23.2%	19.4%	18.2%	9.8%	5.1%	5.9%	6.2%	4.0%
90 km/h – small sample [^]	27.2%	41.3%	34.8%	22.6%	30.6%	6.3%	14.0%	13.6%	11.2%	8.5%
100 km/h	34.5%	34.1%	34.0%	33.4%	26.2%	3.2%	4.8%	4.8%	5.8%	2.2%
110 km/h*	48.1%	39.8%	44.9%	8.8%	5.4%	8.1%	12.9%	8.8%	3.2%	1.2%

[^] Small samples may result in greater fluctuations year to year.

*Note Heavy vehicle speed limit is 100 km/h and results presented indicate the percentage of heavy vehicles exceeding 100km/h in this section.

Overall, the trend in road fatalities and annual speed surveys demonstrates that the mobile speed camera program continues to deliver positive road safety benefits, compared with results prior to the re-introduction of the mobile speed camera program. The general decrease in speeding observed in the annual speed surveys, over the past five years, provides evidence that mobile speed cameras provide a general deterrence to drivers.

With a larger program, there will be greater coverage of the road network at various times and locations and, like police enforcement, this mobility increases the deterrence effect due to the unpredictability of the exact location of speed enforcement.

As announced as part of the *NSW Speed Camera Strategy*, the mobile speed camera program is expanding in 2014 and once completed, will result in about 45 marked vehicles operating for 7,000 enforcement hours per month. This way forward aims to increase the general deterrence of speeding, which is expected to deliver continued reductions in crashes and casualties and reductions in vehicles exceeding the speed limit.

In 2013 there were a total of 13,766 infringements resulting in \$2.59 million in fines from mobile speed camera enforcement. From June 2012, there was a decrease in infringements that can be attributed to the enhanced visibility of mobile speed camera vehicles as well as additional signage being placed before a mobile speed camera to ensure drivers see and recognise the enforcement activity. At the same time, mobile speed cameras also switched from enforcing in both directions to single direction enforcement, further contributing to the lower volume of infringements. In 2013, the number of infringements issued remained at a consistent level over the year.

Since the program was reintroduced in 2010, the compliance rate of vehicles passing a mobile speed camera that are not infringed for speeding remains high. In 2013, over 99 per cent of vehicles passing mobile cameras were not infringed for speeding.

An increase in the volume of infringements is anticipated as the program is expanded to 7000 hours of enforcement per month. Following the program increase the number of infringements is expected to stabilise and return to a downward trend as driver behaviour changes.

CRS has developed and implemented a speed camera public education campaign that has supported the rollout of the mobile speed camera program. CRS evidence shows that enforcement and strong public education campaigns change driver behaviour and help prevent speed-related crashes and trauma through awareness of enforcement.

Red-light speed cameras

The analysis of red-light speed camera locations is available at **Appendix B**.

Overall, there has been a 24 per cent reduction in crashes and a 36 per cent reduction in casualties at the 125 red-light speed camera locations since the cameras were installed compared with a five year period prior to installation. Of the total casualties, there has been a 49 per cent reduction in pedestrian casualties at red light speed camera locations. This reduction in casualties represents a savings of \$70.3 million to the community

There has also been a reduction in the three main intersection crash types with a 37 per cent reduction in adjacent crashes; a 34 per cent reduction in right-through crashes; and a 10 per cent reduction in rear-end crashes. The reduction in rear-end crashes is a positive result for the combination of red-light and speed enforcement because previous research has found that while red-light cameras reduce more severe right-angle crashes, rear-end crashes can sometimes increase. The addition of speed enforcement to red-light cameras is a countermeasure that assists in addressing the small increase in rear-end crashes at red-light speed camera locations. As can be seen from the results, it also reduces pedestrian casualties due to a decrease in vehicle speeds.

In 2013 there were a total of 236,481 infringements resulting in total fines of \$74.75 million at red-light speed camera intersections. In NSW, the penalty for running a red-light is higher than most speeding penalties because the consequences of this behaviour pose a greater risk. Red-light running can lead to severe T-bone and pedestrian crashes where the front of a car impacts with a pedestrian or the less protected side of a car. Generally, around 60 per cent of offences and 80 per cent of fines at red light speed camera locations are attributed to running a red light. Of the total red-light speed camera infringements for 2013: 135,944 (57%) infringements and \$57.78 million in fines were for red-light offences; and 100,533 (43%) infringements and \$16.94 million in fines were for speeding offences.

As part of the *NSW Speed Camera Strategy*, the number of intersections with red-light speed cameras will expand to 200 by December 2015. As the red-light speed camera program continues to roll out, an increase in the volume of infringements is anticipated. However, following the program increase the number of infringements is expected to stabilise and return to a downward trend as driver behaviour changes.

At this stage, red-light speed cameras have not been in operation for long enough for there to be a meaningful trend in infringements. However, it is expected that red-light running and speeding at red-light speed camera intersections will decrease over time, thereby reducing the number of infringements and fines at these locations. While red-light running decreased slowly over time, speeding decreased more rapidly. This demonstrates an improvement in driver behaviour as a result of red-light speed cameras.

Early results for the NSW program also indicate that the expected road safety benefits are being achieved when compared with the evaluation of a similar program in Victoria⁶. While these early results are encouraging, it is too early to conclusively determine the effectiveness of individual locations and therefore no recommendations for review are proposed in this report. Typically at least five years of crash and casualty data are required to make an assessment of a camera's effectiveness.

⁶Budd, L., Scully, J. & Newstead, S.. (2011). *Evaluation of the Crash Effects of Victoria's Fixed Digital Speed and Red-light Cameras*, Report No. 307, Monash University Accident Research Centre., Publicly available from: <http://www.monash.edu.au/miri/research/reports/muarc307.pdf>. Annual NSW Speed Camera Performance Review 2014

The 2013 review identified the below four locations where there has been a fatality since camera operation:

- Griffiths Road and Turton Road, Lambton
- O'Riordan Street and Gardeners Road, Mascot
- Anzac Parade and Lang Road, Moore Park
- Corrimal Street and Burelli Street, Wollongong

These fatalities occurred in 2012. No fatalities were identified in the current review period (2013 calendar year). While the cameras at these locations will not be considered for removal, the Centre for Road Safety conducted an initial investigation into the nature of these fatal crashes, with site investigations conducted at Griffiths and Turton Road, Lambton, and Corrimal Street and Burelli Street, Wollongong.

The investigation at O'Riordan Street and Gardeners Road, Mascot identified no safety deficiencies, and revealed the intersection will be upgraded in the near future as part of re-development work associated with Green Square. No safety deficiencies were also identified at the intersection at Anzac Parade and Lang Road, Moore Park.

Following the site investigation at Griffiths Road and Turton Road, Lambton, the traffic light display for eastbound motorists was upgraded. A mast arm has been installed which slightly overhangs the kerbside lane to improve the visibility of traffic lights to oncoming vehicles. A speed review will also be conducted at this location in 2014.

Following the site investigation at Corrimal Street and Burelli Street, Wollongong, additional pedestrian protection was provided by installing red arrows to control vehicles waiting to turn into adjacent streets. An upgrade to the line marking on Corrimal Street was also completed.

The review identified the 10 red-light speed camera locations with the highest number of infringements detected in 2013. The list is shown at the end of **Appendix B**. Most of the 10 speed camera locations are on main roads with high traffic volumes. As the red-light speed camera program has not been in operation for five years, it is too early to assess the effectiveness of these cameras. However, all had high compliance rates with more than 99 per cent of drivers passing the cameras without being infringed for red-light running and/or speeding.

Fixed speed cameras

The analysis of fixed speed camera locations is available at **Appendix C**.

Overall, when comparing the five years before the fixed speed cameras were installed to the current five year analysis period, the fixed speed camera program has delivered a 42 per cent reduction in the number of crashes, a 90 per cent reduction in fatalities and a 40 per cent reduction in injuries at camera locations. In the five years before the cameras were installed there were 4,212 crashes, resulting in 56 fatalities and 2,254 injuries. In the current five year analysis period there were 2,496 crashes resulting in 6 fatalities and 1,370 injuries. This reduction in casualties represents a savings of \$445.74 million to the community. In 2013 a total of 312,580 infringements were issued resulting in total fines of \$62.91 million at fixed speed camera locations.

Based on the analysis of 95 fixed speed camera locations, eight locations were identified for a preliminary desktop review based on meeting at least one of the crash analysis criteria outlined in the Evaluation method section. These locations were:

- M1 Pacific Motorway, Bar Point
- Richmond Road, Berkshire Park
- Bolong Road, Bomaderry
- Southern Freeway, Gwynneville (southbound)
- Great Western Highway, Hartley
- Pittwater Road, North Narrabeen (school zone)
- Lanyon Drive, Queanbeyan
- Victoria Road, Rydalmere (school zone)

Preliminary reviews of these locations were undertaken to gain an understanding of exactly what had occurred at each location. Based on the preliminary reviews, Richmond Road, Berkshire Park and Great Western Highway, Hartley were identified for safety reviews to be undertaken by CRS. Currently, there are road works underway to upgrade the Great Western Highway, Hartley location, which includes the installation of a point-to-point enforcement length. As these upgrades will improve road safety, this location will not be reviewed until after the completion of road works at this location. The cameras at the other six locations were deemed effective, based on their performance across the entire range of crash analysis criteria. Hence, a total of 93 out of the 95 fixed speed camera locations found to be effective. This positive result is not unexpected, given the review is now in its third year and has systematically identified ineffective fixed speed cameras for decommissioning.

Safety reviews involve a comprehensive examination of crash history, traffic volumes, road conditions, land use and high risk user behaviour near the fixed speed camera location. Safety reviews also involve the consideration of road safety issues raised by the community in regard to the locations. If during the review it is determined that the camera is not delivering the expected safety benefits at the location, it will be recommended for removal and possible relocation.

If a camera is recommended for removal, it will be determined what alternative road safety treatments are suitable to address any identified road safety issues. Alternative treatments may involve improved signage, road works, traffic facilities, speed zoning reviews and targeted communications.

Following the results of the 2011 audit of speed cameras, the Minister for Roads and Freight directed the deactivation of fixed speed cameras that were found to not be delivering the expected road safety benefit at 38 locations. Cameras at seven of these locations remain in warning mode following reviews by CRS and safety concerns expressed by the community. These seven locations are not included in the fixed speed camera analysis, however a report on crash and infringement results since the camera locations began operating under the '3 strikes' warning letter program is available at **Appendix D**.

The review also identified the 10 fixed speed camera locations with the highest number of infringements detected in 2013, excluding cameras located in high-risk locations, such as tunnels. The list is shown at the end of **Appendix C**.

Most of the 10 speed camera locations are on main roads with high traffic volumes. All of these locations were found to be effective in the annual review, delivering crash and casualty reductions. All had high compliance rates with more than 99 per cent of drivers passing the cameras without being infringed for speeding.

Point-to-point speed cameras

The analysis of the point-to-point speed camera program is available at **Appendix E**.

There were 21 lengths of the point-to-point enforcement program rolled out by the end of 2013. However, it is too early to assess the effectiveness of individual point-to-point enforcement lengths as two lengths were installed in 2010, 13 lengths were installed in 2011, five were installed in 2012 and one was installed in 2013. Only one point-to-point length, Great Western Highway between Meadow Flat and Raglan, has enforced for a full three year period (2011 - 2013). At this length, in the five year period before installation (2005- 2009) there were 11 heavy vehicle crashes resulting in one fatality and eight injuries. In the three year post installation period (2011-2013) there were five heavy vehicle crashes resulting in one fatality and two injuries. Infringements issued at this length remain low and have reduced since 2012 indicating an increase in driver speed compliance within the point-to-point length.

A total of 1,267 speeding infringements were issued resulting in total fines of \$501,776 at point-to-point lengths in 2013. Infringement data for average speed offences in point-to-point enforcement lengths shows a high level of compliance within the enforcement lengths and a low number of infringements. This is consistent with results in other point-to-point programs. Numerous studies have shown that point-to-point enforcement is typically associated with very high rates of compliance with posted speed limits even when traffic volume is high⁷. For example, rates of infringement associated with point-to-point

⁷ Soole, D. W., Fleiter, J. and Watson, B. (2011) *Point-to-point speed enforcement: A technological overview, review of the empirical evidence and recommendations for better practice*, Draft final report for Austroads Steering Committee, Austroads, Sydney, Australia.

enforcement (light and heavy vehicles) on the Hume Highway, Victoria have been reported at 1-2 per cent.⁸

Future of NSW speed camera programs

The NSW CRS will continue to annually review all individual speed cameras as well as the overall performance of speed camera programs as set out in the *NSW Speed Camera Strategy*. These reviews will be annually published to ensure that the programs remain transparent to the community.

The fixed speed camera program continues to provide positive road safety benefits to the locations where they are installed, and will be annually assessed to ensure they continue delivering a positive road safety benefit. The NSW CRS will review locations that do not show crash and/or casualty reductions, and will remove cameras at locations that are found to not deliver clear road safety benefits.

While it is too early to assess the effectiveness of the red-light speed, mobile speed and point-to-point speed camera programs, the early results from these programs are encouraging, with evidence of changes in driver behaviour. This is also reflected in an improvement in the provisional road toll for 2013. It is expected that the expansion of the red-light speed and mobile speed camera programs will deliver even greater results than the performance of these programs in 2013. While meaningful analyses of these programs will not be possible for a few more years, CRS will continue to annually monitor their performance.

⁸Soole, D. W., Fleiter, J. and Watson, B. (2012). *Point-to-point speed enforcement*. Austroads Research Report, AP-R415-12.

Appendices

Appendix A: Analysis of NSW mobile speed camera program

Appendix B: Analysis of NSW red-light speed camera program

Appendix C: Analysis of NSW fixed speed camera program

Appendix D: Overview of NSW fixed speed cameras operating in warning mode

Appendix E: Analysis of NSW point-to-point enforcement program