



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.

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 the program. Broadly speaking camera effectiveness is measured by two key criteria:

- The impact the speed camera has on slowing drivers down and therefore reducing crashes and casualties, and
- The impact the speed cameras have on achieving greater speed compliance through a reduction in infringement rates.

Typically at least five years of crash and casualty data are required to make a statistically significant assessment of a camera's effectiveness. The red-light speed camera and point-to-point enforcement programs are in their early stages, with 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 reliably assess 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 2012	Program effectiveness
Mobile	642 locations Approximately 930 hours of enforcement per month	<p>Overall, the trend in road fatalities and annual speed surveys demonstrates that the small-scale interim 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 in 2010.</p> <ul style="list-style-type: none"> • The provisional 2012 road toll of 370 persons killed on NSW roads is the second lowest annual figure since 1932 (with 366 fatalities). • The results of the 2012 annual speed survey were mixed with a decrease in the percentage of light vehicles exceeding the speed limit by up to 10km/h in most speed zones. However when looking at the percentage of light vehicles exceeding the speed limit by more than 10km/h, while there was continued suppression of speeding in 40km/h school zones, 50km/h and 100km/h speed zones, there was a slight increase in speeding in the remaining speed zones compared to 2010 and 2011. <p>The increase in speeding observed in 2012, compared with 2010 and 2011 results can be expected given the size of the program and provides evidence that the general deterrence effect provided by mobile speed cameras can be enhanced by a larger program.</p>

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 2012	Program effectiveness
Red-light speed	106 cameras at 91 intersections	Overall, when comparing the five years before the red-light speed cameras were installed to the post installation period there has been: <ul style="list-style-type: none"> • a 23 per cent reduction in crashes; and • a 30 per cent reduction in casualties at these locations
Fixed	133 cameras at 108 locations*	Overall, when comparing the five years before the fixed speed cameras were installed to the most recent five years there has been: <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 41 per cent reduction in injuries at camera locations
Point-to-point	19 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 108 fixed speed camera locations, seven locations operate in warning mode and six locations are 'high risk' locations (typically located in tunnels). These locations were not included in the fixed speed camera analysis.

** The total proposed point-to-point program is 25 enforcement lengths to be installed by the end of 2013.

Red-light speed cameras

The Centre for Road Safety has identified four locations where there has been a fatality since red-light speed camera operation. While the cameras at these locations will not be considered for removal due to the infancy of the program, CRS will investigate the nature of the fatal crash that occurred and, where appropriate, conduct field inspections to determine whether additional treatments are required to further improve safety at these intersections. The locations are:

- 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

Fixed speed cameras

In this analysis a total of 96 fixed speed camera locations have been reviewed, excluding the seven locations in warning mode and six 'high risk' camera locations. One location, F6, Gwynneville, has two cameras operating approximately 1,000 metres apart and infringing in different directions, therefore these cameras were analysed as two separate locations. The evaluation found that a total of 91 out of 96 locations were effective based on the crash analysis outlined in the report.

There are five locations that were identified for comprehensive safety reviews to be undertaken by CRS due to an increase in crashes and/or casualties at the locations, including:

- Hume Highway, Ashfield (school zone)
- Hume Highway, Bankstown (school zone)
- Fairfield Street, Fairfield East
- McCaffrey Drive, Rankin Park
- Pacific Highway, Sandgate

If during the field reviews it is determined that any camera is not delivering the expected road safety benefits at the location, it will be recommended for removal and possible relocation.

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 annually published 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 or 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.

Speeding increases the risk of having a crash, and increases the risk of serious injury or death in the event of a crash. In addition to car occupants, our roads are used by vulnerable road users such as pedestrians. 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. 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.

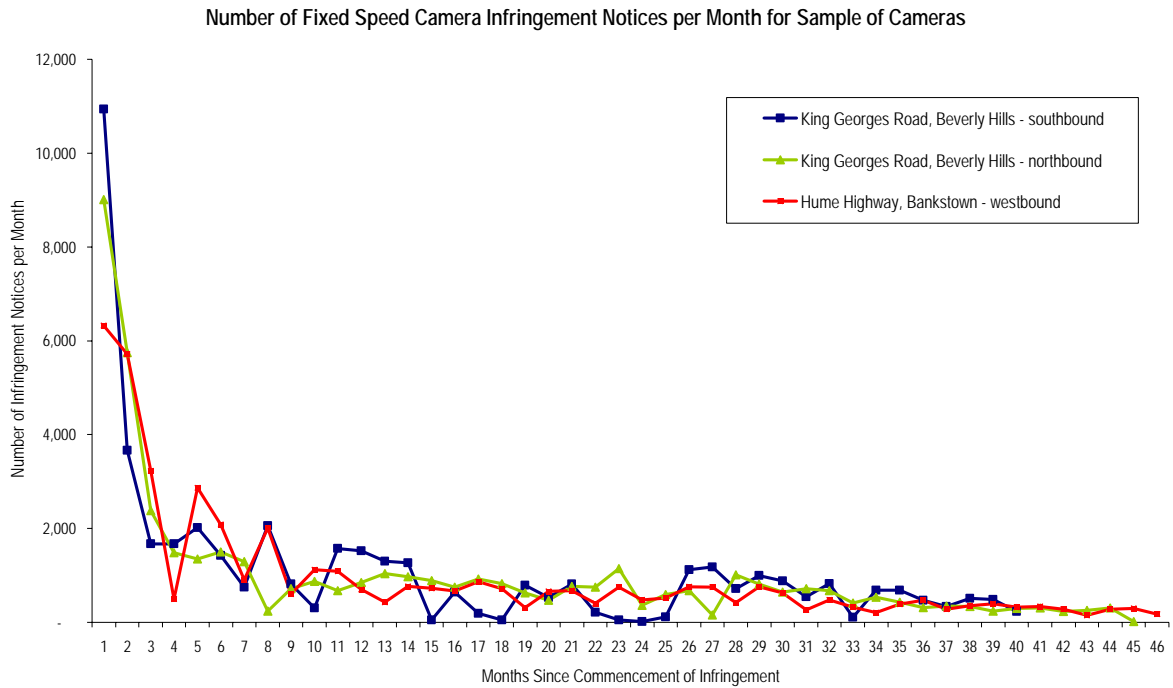
Speed enforcement activities aim to increase the perceived threat of being caught speeding and in doing so help to reduce the mean travel speed on our roads, and therefore reducing the risk of being involved in a fatal or injury crash for all road users. Automated camera enforcement supplements enforcement conducted by police and the NSW Police Force routinely requests locations to be considered for automated speed enforcement. Speed cameras are commonly employed methods of speed enforcement in many best practice road safety jurisdictions throughout the world and have proven safety benefits.

The various types of speed cameras have different roles. In NSW, fixed speed cameras are located at specified road lengths or intersections where there is a demonstrated crash history or where speed is considered to be a problem. Mobile speed cameras can be moved around the 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.

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 which depicts the number of infringements per month since the commencement of enforcement at three high profile 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.



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 2012
Mobile	General network deterrence	First introduced in 1991. Ceased operation in December 2008 and re-introduced in 2010	642 locations Approx 930 hours of enforcement per month
Red-light Speed	Location specific (To address high risk intersections)	2009	106 cameras at 91 intersections
Fixed	Location specific (To address black spot/high risk)	1997	133 cameras at 108 locations*
Point-to-Point	Route enforcement (For heavy vehicles only)	2010	19 lengths**

* Of the 108 fixed speed camera locations, seven locations operate in warning mode and six locations are 'high risk' locations (typically located in tunnels). These locations were not included in the fixed speed camera analysis.

** The total proposed point-to-point program is 25 enforcement lengths to be installed by the end of 2013.

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 also 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 accidents.

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 Transport 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 Ports 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 implementation of a program of alternative safety works has commenced. Cameras at these locations will be removed upon completion of works. Cameras at seven of these locations remain in warning mode following safety concerns expressed by the community.

Following the results of the 2012 annual speed camera review, another nine locations were identified for further review based on the crash analysis criteria. After desktop reviews were undertaken for these locations, four were deemed effective and five were recommended for comprehensive field reviews to be lead by an independent road safety auditor. These locations were: New South Head Road, Edgecliff; Northern Distributor (Memorial Drive), Corrimal; Pacific Highway, Hungry Head (Valla); New England Highway, Kootingal; and New England Highway, Lochinvar. A further location, Cowpasture Road, Green Valley, was also recommended for comprehensive field review to assess whether camera enforcement was still required following a significant upgrade of the road in December 2010.

Reviews of these six fixed speed camera locations were completed in December 2012. The review team, lead by an independent road safety auditor included CRS, councils, nearby schools, NRMA Motoring and Services, the NSW Police Force and local communities. The reviews recommended that the speed cameras at Cowpasture Road, Green Valley and New England Highway, Kootingal be decommissioned while cameras at the remaining four locations be retained as they continue to provide road safety benefits.

In December 2012, cameras at the two locations were decommissioned. Cowpasture Road was upgraded in December 2010 from a two lane road to a four lane divided carriageway with traffic signals and key intersections. Since the upgrade, the crash rate at this location has reduced, as has the severity of crashes. The cameras at this location were removed on 16 April 2013. At New England Highway, Kootingal the safety review found a very low number of crashes and minimal ongoing road safety concerns. The review recommended that the speed camera would be better utilised at another high risk location on the road network. This camera will be removed once minor road safety works have been 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

2012 Road toll data

The crash data used in this annual review include crashes which occurred between 1 January 2012 and 31 December 2012. 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. Based on the experience from previous years, the final road toll for 2012 may be around three per cent lower than the provisional road toll figure.

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 a statistically significant 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 three 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.

Red-light speed cameras

Preliminary analysis of the red-light speed camera program has been conducted by intersection, rather than by camera. There are currently a total of 106 red-light and red-light speed cameras operating at 91 intersections around Sydney, Newcastle and Wollongong with 15 intersections having two 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 2012. 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 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

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.

⁴ New South Wales Centre for Road Safety (2011). *NSW Safety Camera Review*. NSW Roads and Traffic Authority. Publicly available and downloadable from: http://roadsafety.transport.nsw.gov.au/downloads/mobile_speed_camera_review.pdf.

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-through 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-through 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 2012 (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 108 fixed speed camera locations across NSW, 96 fixed speed camera locations were analysed in this report. Of the 108 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 the locations is available at Appendix D. A further six 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, F6, 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 96 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 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 (2008- 2012) 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 six 'high risk' camera locations, crash data has been reported for the 2012 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) 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 \$6.337 million per fatality, and \$0.136 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).
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

⁵ Transport for NSW Principle and Guidelines for Economic Appraisal of Transport Investment and Initiatives, 2012

specific types of crashes that occurred at the location. Where there was additional information which indicated the camera was effective, this is indicated in the report.

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 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 2012 (i.e. 3 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 (2008-2012).
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

There are 25 lengths that are part of the point-to-point enforcement program with 19 of these lengths rolled out by the end of 2012: two lengths were installed in 2010; 13 lengths were installed in 2011; and four lengths were installed in 2012. Of the remaining six point-to-point lengths, two were installed in early 2013 and four are being rolled out later in 2013. There are eight lengths that have enforced for the entire 2012 review period; however this has been for a period of two 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 2012 annual speed surveys were conducted at 164 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 in 2012 were not undertaken at specific speed camera enforcement locations, therefore at camera locations infringement data were used as a proxy for speed data in this review. Speed surveys will continue to be undertaken at a sample of speed camera enforcement locations in the future so that speeding behaviour can be assessed for these programs.

Infringement data

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 publically available through the NSW Office of State Revenue (<http://www.osr.nsw.gov.au/about/corporate/statistics/>). It should be noted that data for prior July 2004 is not currently published on the Office of State Revenue website.

Results and discussion

This review has found that across the four programs, speed cameras are continuing to improve road safety in NSW. Early results in new 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 three of the four programs are still in their infancy and a better understanding of the longer term effectiveness of 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 84 lives and an estimated community saving of around \$490 million.

The immediate impact of the small-scale interim mobile speed cameras is evident. The significant reduction in fatalities (and speed-related crashes) in 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 rollout of the mobile speed camera program was also supported by an extensive communication campaign and media coverage which further reinforced the message for drivers to reduce their speed.

The ongoing impact of the mobile speed camera program is reflected in the provisional 2012 road toll. The provisional 2012 road toll is 370 persons killed on NSW roads. This result is the second lowest annual figure since 1932 (with 366 fatalities). The lowest recorded road toll since 1932 occurred in 2011 with 364 fatalities.

In 2010 there was an immediate and significant reduction in vehicle speeds following the reintroduction of the mobile speed camera program. The results in 2011 showed a continued suppression of speeding, when compared to results from 2008 to 2009 however there were some increases in speeding when compared to 2010.

The results from the 2012 speed surveys were mixed. When looking at the percentage of light vehicles exceeding the speed limit by up to 10km/h, there has been a decrease in speeding in all speed zones compared to the previous year with the exception of 40km/h, 60km/h and 110 km/h speed zones. However when looking at the percentage of light vehicles exceeding the speed limit by more than 10km/h, there has been an increase in speeding in a number of speed zones. While there is continued suppression of speeding in the 50km/h and 100km/h speed zones there was a slight increase in speeding in the remaining speed zones for light vehicles compared to 2010 and 2011. Of particular concern is the larger increase in speeding in the 60km/h as well as the 110km/h speed zones.

The results for heavy vehicles follow a similar trend to that of light vehicles, in that there has been an overall decrease in the percentage of heavy vehicles exceeding the speed limit by up to 10km/h in most speed zones compared to the previous year. When looking at the percentage of heavy vehicles exceeding the speed limit by more than 10km/h, there has been an increase in speeding in the 40km/h, 60km/h, 80km/h and 100km/h. Generally however, a lower proportion of heavy vehicles exceed the speed limit than light vehicles.

The increase in speeding at higher speed zones across both light and heavy vehicles support that 60km/h urban roads and higher speed zones should be the target of future mobile speed camera enforcement.

Overall, the trend in road fatalities and annual speed surveys demonstrates that the small-scale interim 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. However the increase in speeding observed in the 2012 annual speed surveys, compared with 2010 and 2011 results provides evidence that the general deterrence provided by mobile speed cameras can be enhanced by a larger program. A gradual return to pre-2010 results may occur in future years without an increased enforcement presence.

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.

The mobile speed camera program will be expanded later this year and once completed, will result in about 45 marked vehicles operating for 7,000 enforcement hours per month at around 2,500 locations. 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 2012 there were a total of 17,371 infringements resulting in total fine revenue of \$2.87 million from mobile speed camera enforcement. The infringement data for mobile speed cameras show a downward trend in the number of infringements issued during 2012. The significant decrease in infringements from June 2012 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 recognised 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.

An increase in the volume of infringements is anticipated as the program is expanded, coinciding with the increase in the number of sites used for enforcement. Following the program increase and the use of new sites, the number of infringements is expected to stabilise and return to a downward trend as driver behaviour changes.

Red-light speed cameras

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

Overall, based on an annualised average at the 91 intersections, there has been a 23 per cent reduction in crashes and a 30 per cent reduction in casualties at these locations since the cameras were installed compared with a five year period prior to installation. Of the total casualties, there has been a 44 per cent reduction in pedestrian casualties at red light speed camera locations. There has also been a reduction in the three main intersection crash types with a 30 per cent reduction in adjacent crashes; a 30 per cent reduction in right-through crashes; and a 13 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 speed cameras reduce more severe right-angle crashes, rear-end crashes can increase.

In 2012 there were a total of 210,103 infringements resulting in total fine revenue of \$60.19 million at red-light speed camera intersections. At this stage 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 fine revenue at these locations. This was recently shown in an evaluation undertaken by the Centre for Automotive Safety Research in South Australia⁶, which found that in the first year of operation, red-light speed cameras resulted in decrease in red-light running and speeding over time. 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 indicate that the expected road safety benefits are being achieved when compared with the evaluation of a similar program in Victoria. 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

⁶ Mackenzie, J.R.R., Kloeden, C.N., and Hutchinson, T.P. (2012) *Analysis of infringement data from fixed red light and speed cameras at signalised intersections in South Australia*, Report No. CASR071, Centre for Automotive Safety Research, The University of Adelaide, South Australia.

crash and casualty data are required to make a statistically significant assessment of a camera's effectiveness. The Centre for Road Safety has however identified four locations where there has been a fatality since camera operation, including:

- 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

While the cameras at these locations will not be considered for removal, the Centre for Road Safety will investigate the nature of the fatal crash that occurred and where appropriate, conduct field inspections to determine whether additional treatments are required to further improve safety at these intersections.

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 41 per cent reduction in injuries at camera locations. In the five years before the cameras were installed there were 3,959 crashes, resulting in 61 fatalities and 2,124 injuries. In the current five year analysis period there were 2,460 crashes resulting in 6 fatalities and 1,340 injuries. In 2012 a total of 326,173 infringements were issued resulting in total fine revenue of \$59.89 million at fixed speed camera locations.

Based on the analysis of 96 fixed speed camera locations, 91 locations were deemed effective, with five locations recommended for comprehensive field reviews to be undertaken by CRS due to an increase in crashes and/or casualties at the location. These include:

- Hume Highway, Ashfield (school zone)
- Hume Highway, Bankstown (school zone)
- Fairfield Street, Fairfield East
- McCaffrey Drive, Rankin Park
- Pacific Highway, Sandgate

Safety reviews involve examining 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 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 Ports 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**.

Point-to-point speed cameras

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

It is too early to assess the effectiveness of individual point-to-point enforcement lengths as 13 lengths were installed in 2011, with another four installed in 2012. Only one point-to-point length, Great Western Highway between Meadow Flat and Raglan, has enforced for a full two year period (2011 and 2012). 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 two year post installation period (2011-2012) there were

five heavy vehicle crashes resulting in one fatality and two injuries. There were 45 speeding infringements issued at this length in 2012.

A total of 1,617 speeding infringements were issued resulting in total fine revenue of \$1.02 million at point-to-point lengths in 2012. 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 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 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*. 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 Centre for Road Safety 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 the red-light speed, mobile speed and point-to-point speed camera programs are still in their infancy, early results are encouraging, with some evidence of changes in driver behaviour. This is also reflected in an improvement in the provisional road toll for 2012. It is expected that the expansion of the red-light speed and mobile speed camera programs will deliver even greater results than the small-scale programs that operated in 2012. While statistically significant analyses of these programs will not be possible for a few more years, the CRS will continue to annually monitor their performance.

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.

⁸ Soole, 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