

evaluation of the ROAD SAFETY BENEFITS OF THE queensland camera detected offence program (CDOP) IN 2020 & 2021

by

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**Title and sub-title:**

Evaluation of the road safety benefits of the Queensland Camera Detected Offence Program (CDOP) in 2020 & 20121

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**Abstract:**

The Queensland Camera Detected Offence Program (CDOP) covers management and operation of all modes of camera-based traffic enforcement in Queensland. Currently this includes the mobile speed camera program, the red-light camera program and fixed speed cameras, and has been expanded over recent years to include point-to-point cameras, combined speed and red-light cameras at intersections and most recently trailer speed cameras. The broad objective of this study was to measure impacts on crash frequency, severity and social costs to the community in Queensland associated with the ongoing operation of the CDOP over the years 2020 and 2021.

Evaluation results show that the Queensland CDOP was associated with sustained crash reductions across Queensland in the years 2020 and 2021 with correspondingly large economic benefits to the community accruing from its operation. Both fixed and mobile elements of the program produced significant crash reductions. Crash effects associated with red-light cameras, combined speed and red-light cameras (placed at intersections without prior red-light cameras), point-to-point speed cameras, tunnel cameras and road safety camera trailers estimated in the evaluation were robust. In contrast, the evidence of effectiveness for some fixed camera types, including fixed mid-block spot speed cameras and recently installed intersection speed and red-light cameras, remains weaker due to insufficient post-implementation history and small number of camera installations. Despite the expansion of the number of fixed cameras in use under the CDOP, the mobile camera program continues to produce around 91-93% of the measured benefits (in terms of casualty crashes) associated with CDOP reflecting the high proportion of the crash population it covers.

Overall crash reductions in Queensland associated with CDOP were 7.1% for serious casualty crashes and 6.9% for all casualty crashes in 2020 and 8.7% for serious casualty crashes and 8.2% for all casualty crashes in 2021. It was estimated that CDOP was associated with absolute casualty crash savings of 897 in 2020 of which 457 were fatal or serious injury savings and 1,191 casualty crashes saved in 2021 of which 621 were fatal or serious injury crashes. These estimated crash savings correspond to community cost savings of around $503M in 2020 and $678M in 2021, valued using WTP crash costs in 2021 dollars. Analysis showed crash and cost savings associated with CDOP in 2020 and 2021 were less than for recent previous years. This is due to a reduction in mobile speed camera hours of enforcement in 2020 due to COVID-19 and reductions in the percentage of mobile speed camera hours which were conducted covertly (50% reduction) or using LTI/portable devices (39% reduction) both of which were estimated to be the mobile speed camera operation types associated with the highest crash reductions per hour of operation.

The study also presents a protocol for assessing the road safety benefits of installing combined speed and red-light enforcement cameras at signalised intersections currently with no enforcement or red-light camera only enforcement.

**Key Words: Disclaimer**

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| CDOP, mobile speed, fixed speed, red light speed, Queensland, red-light cameras, Quasi-experimental, time series | This report is disseminated in the interest of information exchange. The views expressed here are those of the authors, and not necessarily those of Monash University |

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**Preface**

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Stuart Newstead: Study design, intersection upgrade protocol development, evaluation framework design, and report editing/writing

Laurie Budd: Data preparation, statistical analysis and relevant report preparation

Max Cameron: Project concept, review of manuscript

**Ethics Statement**

Ethics approval was not required for this project.

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Contents

GLOSSARY OF ABBREVIATIONS AND TERMS vi

EXECUTIVE SUMMARY vii

1. Background and aims 1

1.1. Background 1

1.2. Aims 2

2. Data 3

2.1. Crash Data 3

2.1.1. Mobile speed camera site selection and definition 4

2.2. Camera Data 5

2.2.1. Red-light cameras (RLCs) 5

2.2.2. Intersection fixed speed and red-light cameras (RLSCs), mid-block fixed spot speed cameras (FSSCs) and Point to Point speed cameras (PtP) 7

2.2.3. Road Safety Camera Trailers (RSCTs) 8

2.2.4. Mobile cameras 10

2.3. crash costs 12

3. Methods 13

3.1. Evaluation of fixed cdop elements 13

3.1.1. Treatment and control selection 13

3.1.2. Analysis period 18

3.1.3. Analysis by crash type 19

3.1.4. Matching treatment and control crash history 19

3.1.5. Crash savings and community cost savings for the trailer and fixed camera program 19

3.2. Evaluation of the mobile speed camera program 20

3.2.1. Treatment and control area definition and analysis strata 20

3.2.2. Time series periodicity 21

3.2.3. Measures of mobile speed camera operations considered 21

3.2.4. Analysis output and conversion to crash and crash cost savings 21

3.3. combined estimate of state-wide cdop crash effects 22

4. Results 23

4.1. Red-light cameras (RLCs) 23

4.2. Red-light speed cameras (RLSCs) 25

4.2.1. Crash type analysis for red-light (RLCs) and red-light speed cameras (RLSCs) 28

4.3. Fixed Speed Cameras 29

4.3.1. Homogeneity of fixed camera type and site 34

4.4. Road Safety Camera Trailers 35

4.5. Mobile Speed Cameras 39

4.5.1. Analysis model results 40

4.5.1. Crash and crash cost savings associated with the mobile speed camera program over time 49

4.6. State-wide Estimates of CDOP Effectiveness IN 2020-2021 66

5. Future priorities for the intersection camera program 69

5.1. Crash Effects of New RLSC Installations and RLC to RLSC Upgrades 69

5.1.1. RLC to RLSC Upgrade 69

5.1.2. New RLSC Installations 70

5.2. Development of a site ranking formula 71

5.2.1. RLC to RLSC upgrade ranking process 71

5.2.2. Unenforced to RLSC upgrade ranking process 72

5.2.3. Data Used for ranking 73

5.3. site ranking list 73

5.3.1. RLC to RLSC Upgrade 73

5.3.2. New RLSC installations at existing signalised intersections 74

5.3.3. RLSC enforcement at newly signalised intersections 76

5.4. Post ranking process 77

6. Discussion 77

6.1. Crash and community cost impacts by camera type 78

6.1.1. Intersection cameras 78

6.1.2. Fixed mid-block speed cameras 79

6.1.3. Road Safety Camera Trailers 80

6.1.4. Mobile speed cameras 81

6.2. Overall CDOP Impacts 82

6.3. Future CDOP evaluation 83

7. Conclusions 84

8. Appendix 86

8.1. Camera Types 86

8.1.1. Red-light cameras (RLCs) 86

8.1.2. Fixed spot speed cameras (FSSCs) 86

8.1.3. Combined red-light speed cameras (RLSCs) 87

8.1.4. Point-to-point (PtP) cameras 87

8.1.5. Road Safety Camera Trailers 88

8.1.6. Mobile speed cameras 88

8.2. Fixed Speed camera locations and operational data 89

8.3. Control and treatment crash selection 92

8.4. Prior Crash History at fixed camera evaluation treatment and control sites 93

8.4.1. Red-light cameras (RLCs) 93

8.4.2. Fixed spot (FSSCs), point-to-point (PtP) and red-light speed cameras (RLSCs) 94

8.4.3. Trailer cameras 96

8.5. Full list of current RLC sites ranked for RLSC upgrade 98

8.6. Full list of current RLC sites ranked for RLSC upgrade 100

9. References 105

# GLOSSARY OF ABBREVIATIONS AND TERMS

|  |  |
| --- | --- |
| **Term / Abbreviation** | **Meaning** |
| CDOP | Camera Detected Offence Program. |
| GIS | Geographical Information System – a computer program which maps and relates information spatially. |
| Human Capital crash cost (HC) | A method of determining the cost of a road crash to the community based on the actual cost of all the associated events (property damage, medical costs, lost productivity etc.). |
| Negative Binomial regression | A form of statistical [regression analysis](http://en.wikipedia.org/wiki/Regression_analysis) used to model [count data](http://en.wikipedia.org/wiki/Count_data) and [contingency tables](http://en.wikipedia.org/wiki/Contingency_table). It assumes the response variable has a [Negative Binomial distribution](http://en.wikipedia.org/wiki/Poisson_distribution) and assumes the [natural](http://en.wikipedia.org/wiki/Logarithm) [logarithm](http://en.wikipedia.org/wiki/Logarithm) of the response variable can be modelled by a linear combination of a set of independent variables. |
| Poisson regression | A form of statistical [regression analysis](http://en.wikipedia.org/wiki/Regression_analysis) used to model [count data](http://en.wikipedia.org/wiki/Count_data) and [contingency tables](http://en.wikipedia.org/wiki/Contingency_table). It assumes the response variable has a [Poisson distribution](http://en.wikipedia.org/wiki/Poisson_distribution) and assumes the [natural](http://en.wikipedia.org/wiki/Logarithm) [logarithm](http://en.wikipedia.org/wiki/Logarithm) of the response variable can be modelled by a linear combination of a set of independent variables. |
| PtP | Point-to-Point Speed Camera System – an automated enforcement system designed to measure average speed over a length of road. |
| Quasi experiment | A scientific study design similar to the randomised controlled trial except selection of participants to receive the intervention is not random. |
| Relative Risk | The risk of an outcome in one situation or group relative to another (e.g. in males relative to females). |
| Simpson’s Paradox | A situation in statistical analysis where the outcome effects of an action are estimated incorrectly (and more typically in the wrong direction) due to the failure of the analysis to account for the effect of another factor effecting the outcome but associated with the factor of interest. |
| SLA | Statistical Local Area – local geographical areas defined by the Australian Bureau of Statistics. |
| Speed bins | Ranges of speed into which individual speed observations are classified for analysis (e.g. 0-5kph, 5-10kph etc.). |
| Speed enforcement tolerance | The amount over the speed limit a motorist can travel before a traffic offence notice will be issued. |
| Test of homogeneity | A statistical test to establish whether a countermeasure has achieved the same outcome effect over multiple sites. |
| TMR | Transport and Main Roads – a Queensland Government department. |
| Traffic/crash migration | When implementation of a countermeasure causes traffic, and resulting crashes, to move to another site. |
| Willingness to Pay crash cost (WTP) | A method of determining the cost of a road crash to the community based on a survey of the population’s opinion of what it would be willing to pay to prevent a crash and associated injury outcome. |

# EXECUTIVE SUMMARY

The Queensland Camera Detected Offence Program (CDOP) covers management and operation of all modes of camera-based traffic enforcement in Queensland. Currently this includes the mobile speed camera program, the red-light camera (RLC) program and fixed speed cameras. It has been expanded over recent years to include point-to-point (PtP) cameras, combined speed and red-light cameras (RLSCs) and most recently trailer speed cameras. Use of mobile speed cameras since April 2010 has also involved some use of cameras covertly which has been confined to up to 30% of deployment hours.

The broad objective of this study was to measure impacts on crash frequency, severity and social costs to the community in Queensland associated with the ongoing operation of the CDOP over the years 2020 and 2021. An updated evaluation framework for the mobile speed camera component of the CDOP was developed for the 2016 and 2017 analysis and has since provided more robust estimates of associated crash effects and direct links levels of operation of the mobile speed camera program by specific camera type to observed crash outcomes. Using this framework, the effects of the CDOP on crash frequency and costs were able to be estimated both by police region and for Queensland as a whole.

Police-reported data for minor, serious and fatal injury crashes were available up to the end of 2021 for the analysis. Non-injury crash data has not been collected in Queensland past the end of 2010 therefore this analysis was confined to casualty crashes only. Camera installation and operations data were provided by Queensland Police Service (QPS).

Evaluation results show that the Queensland CDOP was associated with sustained crash reductions across Queensland in the years 2020 and 2021 with correspondingly large economic benefits to the community accruing from its operation. Both fixed and mobile elements of the program produced significant crash reductions. Crash effects associated with RLCs, tunnel cameras, PtP cameras and newly installed RLSCs estimated in the evaluation were robust. In contrast, the evidence of effectiveness for fixed spot speed cameras and for some of the more recently implemented fixed camera types (RLC to RLSC upgrades), remains weaker due to limited post-implementation history and, in particular, a small number of camera installations. Despite the expansion of the number of fixed cameras in use under the CDOP, the mobile camera program continues to produce around 95% of the measured benefits associated with CDOP, reflecting the high proportion of the crash population it covers.

The study provided further evidence on the mechanisms of crash reduction effects associated with the mobile speed camera program. Hours of operation of both overt and covert car-based mobile speed cameras were statistically significantly associated with all casualty crashes, with no difference in association by crash severity. Estimated relationship strengths differed between urban and rural areas with a higher percentage crash reductions per hour of enforcement in rural areas compared to urban areas. Furthermore, covert car-based mobile operations were found to produce higher crash savings per hour of enforcement compared to overt operations. The difference between overt and covert effectiveness varied between urban and rural settings, with covert operations being relatively more effective in urban areas compared to overt operations. Associations between portable / LTI cameras and crash outcomes were only found in urban areas where the level of effectiveness per hour enforced was greater than that of overt car-based operations.

Overall crash reductions in Queensland associated with CDOP were 7.1% for serious casualty crashes and 6.9% for all casualty crashes in 2020 and 8.7% for serious casualty crashes and 8.2% for all casualty crashes in 2021. It was estimated that CDOP was associated with absolute casualty crash savings of 897 in 2020, of which 457 were fatal or serious injury savings, and 1,191 casualty crashes saved in 2021, of which 621 were fatal or serious injury crashes. Conversion of the estimated crash savings into (2021 $) cost savings estimated annual savings of around $503M in 2020 associated with the program, valued using WTP estimates. The corresponding economic savings in 2021 were $678M. About 90% of the total savings stem from savings in fatal and serious injury crashes which are the focus of the Queensland road safety strategy.

Estimated crash reduction for the CDOP in 2020 and 2021 were lower than those estimated for 2018 and 2019 in the previous evaluation. Analysis showed crash and cost savings associated with CDOP in 2018 and 2019 were the greatest of any year of the program being over 22% higher than the previous best year of 2017. This was largely attributable to the significant increase in the hours of mobile speed camera enforcement in 2018 and 2019. There were two key reasons for lower estimated crash savings in 2020 and 2021 compared to the previous two years, both relating to the mobile speed camera program. Mobile speed camera hours dropped in 2020, most likely as a result of the COVID-19 pandemic. Despite mobile speed camera hours in 2021 returning to similar levels achieved in 2019, estimated crash effects associate with CDOP in 2021 were still lower than estimated for 2019. Analysis showed that this was primarily due to the change in the mix of mobile speed camera operation types. Both 2020 and 2021 saw a decline in the proportion of mobile speed camera operational hours that were portable/LTI and covert, both of which were estimated to be the most effective mode of mobile speed enforcement operation to achieve the highest possible crash reductions. Greater road safety benefits of CDOP could be achieve in the future through a return to higher proportions of cover car-based and portable / LTI operations in the mobile speed camera program in preference to overt car-based operations as achieved in 2019 and 2019.

To inform the potential upgrade of current signalised intersections with red light camera enforcement only or no camera-based enforcement to have combined speed and red-light camera enforcement, a protocol for ranking sites for upgrade was established. The protocol developed is based on the community cost savings of crashes estimated to be potentially prevented by installation or upgrade to a combined speed and red-light camera. It was successfully applied to estimate the road safety benefits of upgrading the 113 current red-light cameras to include speed enforcement or installing new speed and red-light cameras at 441 currently unenforced intersections.

# 

# Background and aims

## Background

The Queensland Camera Detected Offence Program (CDOP) is jointly managed by Transport and Main Roads (TMR) and the Queensland Police Service (QPS). It covers management and operation of all modes of camera-based traffic enforcement in Queensland. Currently this includes mobile speed cameras, red-light cameras (RLCs), combined red-light / speed cameras (RLSCs), fixed spot speed cameras (FSSCs), point-to-point (PtP) speed camera systems and most recently road safety camera trailers (RSCT). Road safety trailer cameras are deployed to high-risk areas including highways and motorways, roadworks sites and school zones. Unlike other mobile cameras, which are sited only for short time periods and manned during operation, the road safety trailer cameras are left on site for longer periods with operation managed and monitored remotely with daily checks.

As well as expanding the types of cameras deployed under the CDOP, there have been operational changes to the program as well. These include the criteria by which sites are chosen for enforcement as well as types of mobile cameras in use and the way in which they are deployed. Initially, vehicle mounted cameras were the only type of mobile speed camera in use. Over the life of the program, these have been supplemented with hand held portable units used at the roadside. Initially, all mobile speed camera operations were deployed overtly with associated signage. Since April 2010, a proportion of operations have been deployed covertly in both urban and rural areas. The proportion of covert operations has varied over time. Significant expansion of the number of sites enforced by the mobile speed camera program and its associated coverage of the Queensland crass population has also occurred over the life of the program.

To inform the ongoing management and development of the program, evaluations of the program have been conducted previously at regular intervals. The Monash University Accident Research Centre (MUARC) developed an initial evaluation framework for the CDOP when its only component was the mobile speed camera program (Newstead and Cameron, 2003). The framework was applied to estimate the crash and economic impacts of the mobile speed camera program from its introduction in 1997 to June 2001. A further component of the initial study was to relate mobile speed camera operational measures to estimated crash outcomes to ascertain the most important operation parameters of the program that determined effectiveness.

With the progressive introduction of other camera types under CDOP, including PtP camera systems, combined RLSCs and fixed digital cameras, TMR commissioned MUARC to develop a new evaluation framework to measure the crash and economic impacts of each of these camera types in addition to the mobile speed camera program. An evaluation framework was developed and successfully applied to evaluate the CDOP to the end of 2008 including the impact of each individual camera type as well as the combined impact of the CDOP on reducing crashes across Queensland (Newstead and Cameron, 2012). The evaluation framework also incorporated the assessment of changes in measured travel speeds in Queensland using data collected from periodic state-wide travel speed surveys as an intermediate measure of CDOP effectiveness. This evaluation framework was reapplied periodically to provide ongoing assessment of the road safety performance of the Queensland CDOP in the years 2009-2012 (Newstead and Cameron, 2014), 2013-2015 (Newstead, Budd and Cameron, 2017), 2016 (Newstead, Budd and Cameron, 2018) and 2018 (Newstead, Budd and Cameron, 2020).

In response to a number of deficiencies noted in the evaluation framework used to evaluate the CDOP up to 2017, particularly in assessing the impacts of the mobile speed camera program which had changed significantly in its coverage, camera types used and deployment strategies, TMR commissioned MUARC to develop a revised framework for the evaluation of the crash and economic impacts of CDOP. Although using similar evaluation methodology for the fixed CDOP elements as used previously, the revised evaluation made significant changes to the way in which the mobile speed camera component of CDOP was assessed. Instead of looking purely for relative intervention effects between enforced and unenforced mobile speed camera sites, the new framework assessed the relationship between mobile speed camera operational outputs in each police region, as measured by hours of enforcement, considering each type of mobile camera enforcement (car based overt, car based covert and portable / LTI enforcement) separately. In addition, analysis was based on the new sector-based partitioning of Queensland for enforcement scheduling, identifying those sectors which had been enforced at some stage during the program and differentiating effects in rural and urban sectors. Through this framework, it was possible to measure the relative impacts of each mobile speed camera operation type on crashes per hour enforced.

The revised evaluation framework for CDOP is described in Newstead, et al (2020) which also demonstrated the application of the framework to estimate road safety benefits of the CDOP in 2017. Further application of the new framework was made to estimate the road safety benefits of the CDOP in 2018 and 2019 (Newstead et. al., 2021).

## Aims

The primary aim of the project was to apply the latest CDOP evaluation framework developed by Newstead et al (2020) to estimate the road safety benefits of the CDOP in the 2020 and 2021 calendar years including additional evaluation of the trailer camera program first considered in Newstead et al. (2021). Results of applying the evaluation framework will be used by TMR to report publicly on the crash effects and associated economic savings of the CDOP and to guide future policy development and analysis.

As per the previous application of evaluation framework, the current application aimed to estimate crash outcomes associated with the CDOP both in aggregate and by crash severity level. Percentage crash savings were converted to absolute crash savings and subsequently into social cost savings per annum using both Willingness to Pay (WTP) crash costs provided by Queensland TMR. Furthermore, estimates of the effectiveness of individual program elements were brought together to arrive at aggregate effectiveness estimates both within specific police regions as well as across the whole of Queensland. This involved consideration of the crash population covered by each mode of enforcement.

An additional aim of the current evaluation was to establish priorities for the upgrade of existing red light only cameras to combined speed and red-light cameras as well as for expansion of the combined speed and red-light camera program to currently unenforced signalised intersections in Queensland. Specifically, the project aimed to provide a ranking for the upgrade of the existing 113 red light camera sites to combined speed and red-light enforcement as well as estimates of the combined road safety benefits of upgrading all 113 sites. Generation of a priority ranking list for upgrading currently unenforced intersections to speed and red-light enforcement was an additional aim.

# Data

## Crash Data

The Data Analysis Unit within TMR supplied MUARC with crash data covering the period from January 1992 to December 2021 inclusive. Property damage only crashes were not reported beyond the end of 2010. The data covered all crashes reported to police in Queensland with each unit record in the data representing a unique crash. A total of 541,797 crash records were contained in the data; 375,703 pertained to casualty crashes. The data included the following fields pertaining to the crash:

* Unique crash identification number
* Date of occurrence
* Severity (fatal, hospitalisation, medically treated injury, other injury, no injury)
* Police region
* Statistical Local Area
* Speed limit
* Street on
* Intersecting street
* Traffic control
* DCA code (Definition for Classifying Accidents)
* Roadway feature (intersection geometry, bridge, etc.)
* Divided/undivided carriageway
* Number of lanes
* Speed related crash indicator
* Number of traffic units involved in crash
* Sector ID, activation date, urban/rural status and urban centre name for crash
* Distance from five closest mobile speed camera sites and the unique site identifiers for the five closest mobile speed camera areas of possible influence including: sites, sectors, weighting areas and zones, all of which are further defined in the next section.
* Distance from the three closest FSSC sites and the unique site identifiers for the three closest FSSC sites
* Distance from the five closest Trailer camera sites and the unique site identifiers for the three closest Trailer camera sites
* Distance from the closest RLC site and the unique site identifier for the closest combined RLC site
* Distance from the closest combined RLSC site and the unique site identifier for the closest combined RLSC site
* Distance from the closest average speed camera site and the unique site identifier for the closest average (PtP) speed camera site
* GDA latitude and longitude for the crash
* WTP 2019 Crash cost
* HC 2019 Crash cost

In addition, for certain road segments where available, average annual daily traffic volume was provided and for some intersections where available, an intersection ID was provided.

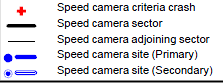
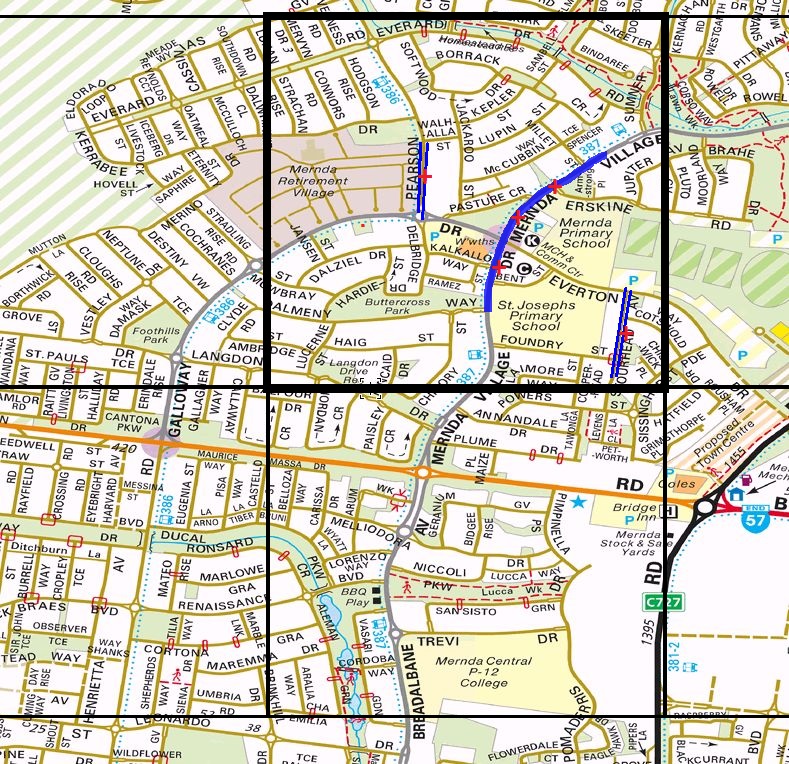
### Mobile speed camera site selection and definition

From the commencement of the Queensland mobile speed camera program in 1997, zones for mobile camera operation were defined as a 1-kilometre (urban) or 5-kilometre (rural) diameter circle which was approved enforcement based on prior crash or speeding history or public reporting of a road safety problem. Once a zone was identified for potential mobile speed camera enforcement, Queensland Police Service would undertake an operational assessment to identify locations within the zone for mobile speed camera sites based on safe operation of the camera. They were able to pick multiple sites within the zone if necessary or reject the zone as not suitable. Previous evaluation of the mobile speed camera program in Queensland has defined the area of influence of the mobile speed camera program relative to the centre of the zone of operation.

During 2016, Queensland TMR changed to a new methodology for partitioning Queensland into areas for consideration of mobile speed camera enforcement. Previously areas for enforcement were based on circular zones which left gaps in areas of the road network considered. Transition to square sectors allowed all of Queensland to be considered for mobile camera enforcement. All areas of Queensland were divided up into nominally square sectors of 1km side length in urbanised (built up) areas and 5km side length in rural areas. The concepts of sectors, segments and sites are illustrated in Figure 1.

Each sector was assessed for enforcement and each sector included sites chosen for enforcement based on operational and safety criteria which included consideration of the frequency and severity of crashes.

As evident from Figure 1, the spatial disaggregation of Queensland for the purpose of speed camera operations siting allows multiple potential references for relating crash occurrence to speed camera operations. These include the specific camera site, the weighting area or the whole of the sector. Under the revised evaluation framework of Newstead et al (2020), analysis of the mobile speed camera program crash effects is based on the sector partitioning of Queensland with each sector representing an analysis unit with each being dichotomised as enforced or unenforced based on the presence of a mobile speed camera operation in that sector at some time since implementation of the mobile speed camera program in Queensland.



A sector is a rectangular (or polygon) block which may contain sites where mobile speed camera operations are carried out. To the left is a bolded block with examples of primary and secondary speed camera sites and speed camera criteria crashes (illustrative only and not from the Queensland program).

A speed camera site may be defined as a point, or a segment of road (blue line), which is called a “weighting area” in the crash data. The actual site of the scheduled operation may occur anywhere along this segment. Such a block would be defined as a treatment block in the evaluation. Under this block is another sector which has no mobile camera sites which would be used as a comparison or control site in the previous evaluation framework.

A zone is defined as a circle with a 1km radius in urban areas and a 5km radius in rural areas. The centre of the zone is the site/area centroid.

Figure 1 *The new format for the identification of mobile speed camera operations*

## Camera Data

### Red-light cameras (RLCs)

The provided crash data allowed the identification of crashes within 100m of 115 RLCs. This identification process could be extended to include four additional cameras (60, 69, 110 and 157) which were located at the same intersections as identified cameras (40, 500, 119 and 158 respectively), and included five cameras now located at intersections with a red-light speed camera (14, 157/158 and 110/119). Furthermore, crashes were also identified as 100m from RLSC at intersections where an RLC was previously located; this provided data on crashes within 100m of an additional 18 red light cameras. Crashes for one of the analysed cameras (115**:** Gold Coast Highway & Government Road, Labrador) were manually identified, using street names because the crash data provided placed the site at an incorrect location.

Crashes in the current data were not identified for the cameras at the intersection of Kessels Road and Mains road. Three cameras were sited in different points within the intersection of Kessels Road and Mains Road (5, 76 &77), however camera 5 was decommissioned more than four years prior to the go-live dates for cameras 76 and 77. (The analysis of crashes associated with cameras 76/77 were referenced against these four years of pre-period.) Cameras 76 and 77 do not appear to have been parked or decommissioned. Crashes identified near to cameras: 76 and 77 in the data of previous analyses were considered and a manual identification was used to identify crashes near to these cameras in 2020 and 2021.

The 140 red light cameras (23 of which have been upgraded to RLSCs) at sites where crashes had been observed over the study period, were located at 126 (20 of which have been upgraded to RLSCs) unique intersections. Four cameras were positioned at different locations at the junction of the Gateway Arterial and Old Cleveland Road in Belmont (62-65). Eleven intersections had two red-light camera sites (7/55, 37/54, 40/60, 43/52, 67/68, 76/77, 110/119, 157/158, 206/209, 460/462 & 69/500). Three of these intersections (in blue) now have red-light speed cameras.

As noted, twenty-three of the 140 cameras were placed at the 20 intersections where red-light speed cameras were later installed. Three of these intersections had two RL cameras (110/119, 157/158 and 67/68). The crashes associated with these 20 intersections were partitioned so that the crash and economic effects for both the RLC (prior to upgrade) and the speed camera upgrades could be estimated.

Cameras with less than three years of crash data prior to the ‘*go live’* date for the intersection, were excluded from the analysis due to issues of statistical analysis power and stability in the evaluation. Sixty-four of the 140 red-light cameras (with associated crash data) went live prior to 1995; nine of these became RLSC sites (13, 14, 19, 83, 153, 154, 252, 304 and 353); three were one camera of multi-camera intersections (62-65, 37/54 and 7/55). Although the crash effects at these RLC sites were not able to be estimated, provided that the site was identified in the crash data and the camera was ‘live’ in during 2020 or 2021, the overall contribution of these sites to road trauma outcomes in Queensland were considered by assuming the average crash effects estimates for the sites evaluated applied equally to the sites not evaluated.

Crashes near 13 decommissioned or parked RL cameras (2, 5, 33, 51, 81, 107, 111, 120, 127, 201, 251, 303 and 352) were not identified in the crash data. Information about the location of these cameras was provided in the data provided for previous CDOP analyses. For the crash years prior to 2018, spatial data from previous analysis years could be used to identify crashes prior to decommissioning within 100m of each of these cameras. Crashes occurring in 2020 and 2021 generally occurred after their decommissioning, however the intersection location of those within the operational times were matched with RLC metadata from previous CDOP analyses to determine proximity to a decommissioned camera. Crashes found to be both within the operational period and 100m proximity were excluded from the fixed camera analyses. Exclusion meant that these cameras, which were not active in 2020 and 2021 were not included in the 2020-2021 evaluation of fixed cameras.

The measured effects of several red-light cameras (36, 84, 94, 151, 152, 402 and 411) included the effects of trailer fixed speed cameras operating with coincident or overlapping zones of influence.

All RLCs were made active prior to July 2014, so all have at least 18 months of ‘*after go-live’* crash data.

During the study period (1992-2021), all intersections with (included) RLCs and associated crash data had at least one camera site at the intersection upgraded to, or installed as, a digital red-light or digital RLSC. For all RLCs considered in the study, it was assumed that all posts and camera housing remained in place until decommissioning so that effective deterrence remained plausible from the ‘*go live’* date to the end of 2021 or until the decommissioning date.

### Intersection fixed speed and red-light cameras (RLSCs), mid-block fixed spot speed cameras (FSSCs) and Point to Point speed cameras (PtP)

As of December 2021, there were thirty-five digital RLSCs operating in Queensland: each one is located at a different intersection with one exception: the intersection at Bridge and McDougall Streets, Toowoomba has two cameras (483157 & 483158). No new RLSCs, went live in 2020 and 2021. One additional RLSC was operating in 2020 (683353 at location 2007) until March 18, when it was decommissioned.

Fifteen RLSC locations were analysed using a no-camera before period, as these locations were not upgraded from RLC sites but were installed at previously unenforced intersections (QPSID: 283006, 283067, 283078, 383071, 383078, 483095, 483096, 483159, 583085, 583086, 683256, 683257, 783211, 883305 and 883306 which were originally GIS coded as: 2002, 2015-2024, 2026-2027, 2108-2109). All have at least 2 years of post-installation operating period as at the end of December 2021.

The other 21 RLSCs at the other twenty intersection locations were installed at sites previously enforced by RLCs, so were analysed as upgrades with the ‘before’ period being when the RLC was operational. The RLCs for these locations were evaluated with the before implementation period being where there was no camera operational at the sites and the post-implementation period being when the RLC was operational but before installation of the RLSC. As previously stated, ten of these twenty-one: 183013, 183014, 283019, 483153, 483154, 583083, 583412, 683252, 683353 and 883304 (originally GIS coded as: 2005, 2006, 2007, 2010, 2011, 2025, 2029, 2103, 2105 and 2106); had no sufficient period prior to RLCs, so for these ten, no red-light camera evaluations were made.

As with RLCs, the overall contribution of all RLSC sites to road trauma outcomes in Queensland were considered by assuming the average crash effects estimates for the sites evaluated applied equally to the sites not evaluated. Although, where the analysis allowed, all RLSC sites active during the crash data period were analysed.

There were nine analogue FSSC (one per site) made active prior to 2012. One of these, camera 480001 (previously GIS coded as 3006) located on the Warrego Highway in Redwood was not included in the crash data nor in the current QPS and TMR metadata. This camera was decommissioned in December 2013. It was reassigned to roadworks speed limit enforcement and it was assumed that housing structure and signage was removed from the Warrego Highway on decommissioning. The other 8, located at separate locations, have been upgraded (in 2014 and 2015) to digital and remain operational.

One FSSC that operated only as a digital camera (from 2011) was decommissioned prior to 2020. Camera 180111 (previously GIS coded as 1001) on the Gateway Motorway, Nudgee, was placed into maintenance early in 2016 and decommissioned in April 2016. It was not included in the crash data nor in the current QPS and TMR metadata. It was reassigned to roadworks speed limit enforcement and it was assumed that housing structure and signage was removed on decommissioning. For these reasons, crashes associated with the operation of these two cameras were excluded from this 2020-2021 analysis.

There were six speed cameras at two locations on the PtP section of the Mt Lindesay Highway, South Maclean. This system was decommissioned in 2019 due to the installation of a set of traffic lights within the system and other upgrades to the highway. For these reasons, crashes associated with the operation of this camera have been excluded from this 2020-2021 analysis.

Including the 8 upgraded from analogue, there were 56 fixed digital speed cameras at 30 locations operating in 2020 or 2021. All but six were activated prior to December 2015; these six were PtP cameras at 3 locations on the Toowoomba Second Range Crossing and were activated in 2021.

* Eight at three locations, on the PtP section of the Bruce Hwy, (The fixed spot speed cameras, 580011 and 580012 are now reported separately by QPS)
* Six marking three point-to-point sections (in each direction), on the Toowoomba Second Range Crossing,
* Ten in the Airport-Link Tunnel (at four locations)
* Six in the Legacy Way Tunnel (at two locations)
* Eight in the Clem 7 tunnel (at four locations)
* Four at location number 1002, Loganholme (with one in each of four lanes)
* Five at location 1012, Gaven (with one in each of five lanes)
* Nine cameras operating as the only camera at locations: 3001, 3002, 3003, 3004, 3005, 3007, 3008, 3009 & 1011

The active average speed PtP camera system, operating on a segment of the Bruce Highway between Landsborough and the Glass House Mountains, began operation five months after the FSSCs operating at each end of the average speed camera system on this road section went live. The PtP system was extended to Elimbah in 2017. Extensive road works in recent years have limited the PtP functionality of these cameras. Three road safety trailer camera zones of influence were coincident with the zone of influence of the Bruce Highway PtP system, so effects measured for the P2P system include the effects of 587904, 587912 and 587913 RSCTs.

Further, the following trailer operations were within the analysis of fixed spot speed cameras because of co-incident or overlapping zones of influence: 387912 (1012), 587911 (3001), 287902 (3003), 487901 (3007) and 587901 (3009). Trailer operations also overlapped the zones of influence of red-light speed cameras: 2010, 2012, 2021 and 2024. For the purposes of analysis, the crashes within these coincident or overlapping zones of influence were considered to only be at fixed spot and red-light speed camera sites.

### Road Safety Camera Trailers (RSCTs)

Mobile trailer speed camera operations began December 22, 2016 with targeted operations. Trailer operations were extended to school zone and roadwork speed enforcement in 2017 (January and April respectively). Within this document, a trailer operation was defined as continuous daily enforcement with breaks in continuity of less than one week. Operations during 2020 and 2021 were identified with 61 different six-digit site numbers. Up to seven operations were carried out for each site number. Operations for 61 site numbers were carried out at uniquely identified site locations, from December 22, 2016 to December 30, 2021: Two roadwork, 18 school and 41 targeted. Additionally, over the same period, 56 site numbers were clustered into 22 locations because of overlapping camera zones of influence:

1. Gateway Motorway roadworks, Nudgee beach: 185: 903,906, 907, 910 & 911.
2. Gateway Motorway roadworks, Boondall: 185: 904, 909 & 912.
3. Old Cleveland road targeted, Belmont: 287909 and 287910 (exact location match).
4. Bruce Highway targeted, Parklands: 587905 & 587906 (exact location match).
5. Bruce Highway targeted, Woombye and Kiels Mountain: 587909 & 587910.
6. Mt Lindesay Hwy, Jimboomba: 386903 is school zone, 387905 is targeted.
7. Pacific Highway, Slacks Creek and Daisy Hill: 385919 & 385920 are road works, 387919 & 387920 are targeted.
8. Pacific Highway, Eagleby: 385906 is road works, 387906 is targeted.
9. Pacific Highway targeted, Yatala: 387907, 387918 & 387927.
10. Brisbane Rd, Bundamba: 486901 is school zone, 487903 is targeted.
11. Ham Rd, Mansfield: 286901 is school zone, 287903 is targeted.
12. Wembley Rd school zone, Logan Central: 386901 & 386902.
13. Warrego Hwy targeted, Gatton: 487907 & 487913.
14. Pacific Highway, Ormeau/Pimpana: 385908 is road works, 387: 901, 908, 909 & 917 are targeted.
15. Pacific Mwy, Pimpama: 385916 is road works, 387916 is targeted.
16. Pacific Mwy targeted, Coomera/Upper Coomera: 387910 & 387915.
17. Pacific Mwy targeted, Helensvale/Oxenford: 387911 & 387913 .
18. Pacific Mwy, Mudgeeraba/Robina/Varsity Lakes: 385921 & 385922 are road works, 387902 is targeted.
19. Bridge St, Wilsonton School Zones: 486906 & 486907.
20. Logan Motorway, Kingston targeted: 287907 & 287908.
21. Mount Lindesay Highway: 386908 is school zone, 387904 & 387924 are targeted.
22. Gympie Arterial Road, Bald Hills: targeted187904 & 187911.

Of the cameras located at uniquely located sites, 6 were decommissioned prior to December 31, 2021: 2 targeted (187905 on 01/11/2021 and 387914 on 20/04/2021), 2 School Zone (186901 on 19/04/2021 and 286902 on 16/10/2018) and 2 Roadworks (185901 & 185905 on 19/04/2021). The camera (286902), decommissioned prior to 2020, was excluded from this analysis.

Fifteen roadworks cameras that were analysed within clusters were decommissioned on April 19, 2021: Cluster 1 - 185911, 185903, 185910, 185906 and185907; Cluster 2- 185912, 185904 and 185909; Cluster 7- 385920 and 385919; Cluster 8- 385906; Cluster 14- 385908; Cluster 15- 385916 and Cluster 18-385921 and 385922. Four targeted cameras that were analysed within clusters were also decommissioned prior to 31/12/2021: Cluster 9- 387907 on 21/04/2021 and Cluster 18- 387902 on 19/11/2021

As can be observed, operations of different types were possible at cluster locations. Clusters were necessary so that treatment and control sites could be identified along the lengths of a single road. Periods of operation were used to distinguish treatment operation types, so that analyses could be stratified by type. This required that controls for targeted and roadwork operations were shared for clusters 7, 8, 14, 15 and 18. As different lengths of 40 km/hr zoned roads were used as controls for school zone treatments, controls did not need to be shared for clusters 6, 10, 11 and 21.

A summary of fixed speed camera sites available for evaluation is presented in Section 8.2 of the Appendix. Not considering the new Toowoomba P-t-P system, which has been operating for only 3 months of the analysis period, the shortest post-activation observation periods for fixed road safety cameras are for RLSCs which have a minimum of 2 years.

The pre-activation period for all fixed spot, average, trailer and RLS cameras exceeded the suggested three year minimum period for minimisation of regression to the mean effects by providing an accurate base estimate of the underlying crash rates at each camera site. It is not known whether this period is coincident with the time period used to identify each site as a candidate for enforcement. However, using a long pre-installation evaluation time period maximises the chance that this time period is not fully coincident with the selection period hence further minimising regression to the mean prospects.

The post-activation period of crash data has made it possible to consider analysis of digital fixed spot speed and RLC effects disaggregated by police region. Disaggregated by severity and region, low crash counts and the relatively few cameras, each with very specific halos of influence, has meant that statistical power was insufficient to draw conclusions with statistical significance from this analysis. However, over all regions, for all combined fixed cameras (and also individually for some specific camera types), strongly significant injury crash reductions were estimated. Hence overall estimates of average camera effectiveness were the focus of the analysis.

### Mobile cameras

Data on the hours and locations of mobile camera operations were provided by QPS with the locations subsequently matched to crash data to determine the spatial distribution of crashes in relation to camera locations. Data were also aggregated into tables summarising the hours of deployment per month (or quarter), deployment type (digital or analogue mobile speed, portable speed), deployment site number, camera type (vehicle mounted, tripod mounted or hand held) and covert/overt status. Vehicle mounted cameras consisted of digital, analogue or wet film deployment types and operations could be covert or overt. A small percentage of digital mobile speed camera operations were classed as other or ‘N/A’, these were considered ‘overt’ for the purposes of this analysis. Portable mobile speed cameras, also known as LTI cameras, were either tripod mounted or hand held. Given the nature of hand-held operations, no distinction was made in the classification of operations as overt or covert. In comparison, car-based operations were dichotomised as overt or covert based on their description in the operations data.

In order to place sites into the appropriate geographical sectors for analysis, TMR provided a correspondence table between site and sector at the time of the 2018 and 2019 analysis. Also included in the correspondence table was the urban or rural classification of the sector. Updates to the urbanisation of sectors were not provided with the 2020/2021 analysis data. Updates to the region of location that were provided used new regions which were not consistent with the region names previously used. This means that updates to regional definitions were fixed at the 2018/2019 boundaries, however, updates to the sector urbanisation was possible if crash data for the sector was available. A small percentage of sectors had both urban and rural crashes (according to CDOP crash variable based on current ABS SLA) and the modal crash urbanisation was used to update the urbanisation classification in 0.5 percent of sectors in Queensland.

Notable features of mobile camera deployment included:

* Deployment hours increases in January and July 2013 and July 2014 and a significant increase in total hours enforced from 2018, carrying through in to 2019 (see Figure 2)
* A reduction in the enforcement thresholds staggered by speed zone over the period July 2013 to June 2014
* A steady increase in the use of portable speed cameras with a trial of the Poliscan system in the second half of 2014 (see Figure 2)
* Removal of the requirement for signage of mobile speed cameras in July 2015
* Implementation of a new operations scheduler in May 2016.

Figure 2 shows the number of hours of mobile speed camera operations per quarter year by mobile camera type and overt/covert nature for the whole of Queensland broken down by urban and rural sectors, from 2018. Prior to April 2010, operations were only car mounted of the overt type. Portable cameras were relabelled LTI in 2016. Although a proportion of the LTI operations were labelled as being covert, the nature of LTI and portable camera operations suggests they are all likely to be relatively overt in nature, being hand operated at the roadside. As such, all portable and LTI operations have been combined for consideration in the analysis and assumed to be overt. Further, from 1992 LTI operations included a small proportion specifically targeting motorcycles. Car-based operations have been considered separately based on overt and covert operation.

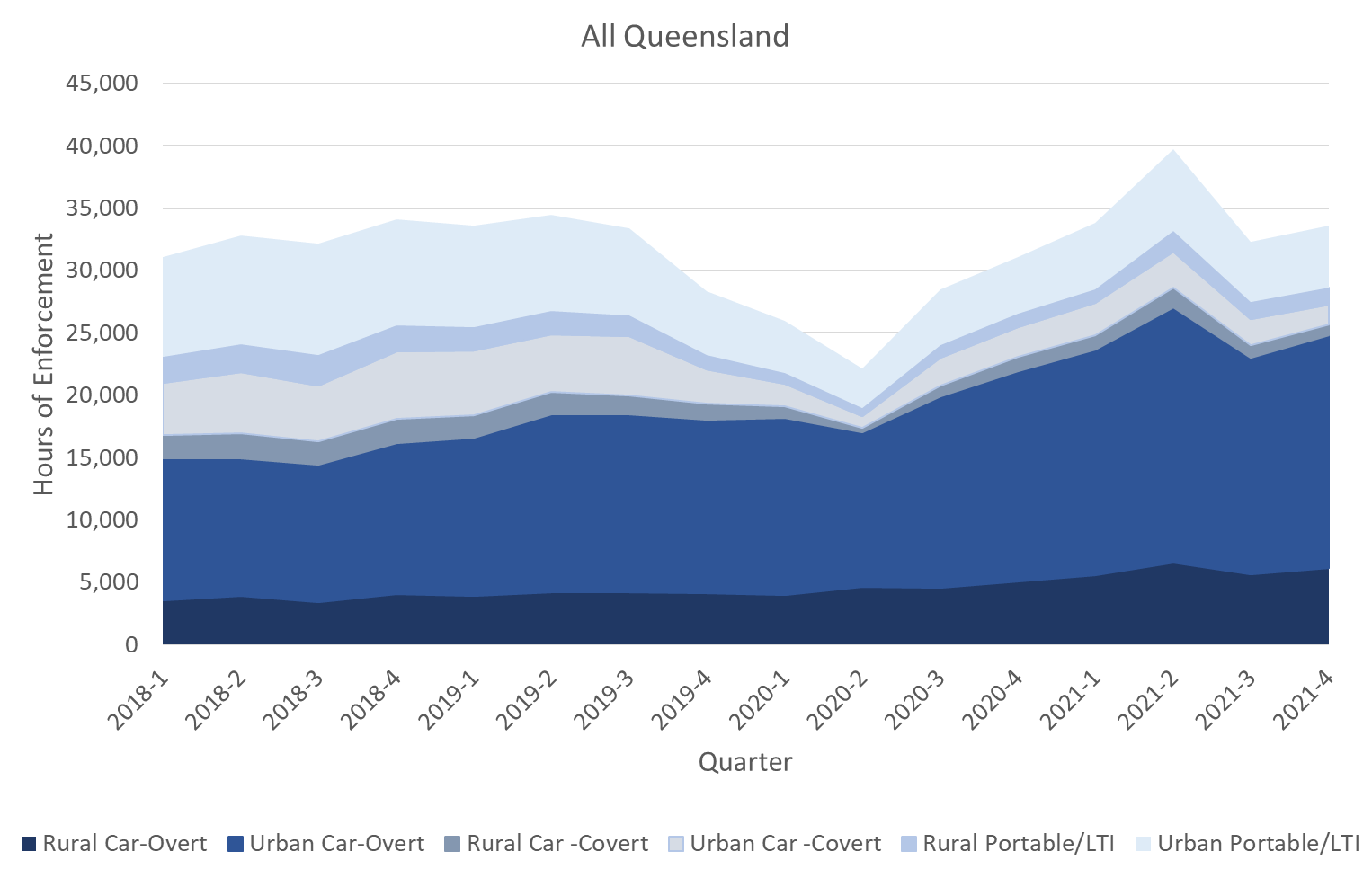


Figure 2 *Quarterly mobile speed camera hours by mobile camera type, operation nature, urban and rural areas of Queensland*

Figure 2 shows a dip in hours of overt and LTI enforcement coincident with the COVID-19 Pandemic. Other than this dip, there is a trend in increased operational hours across all categories since 2018 through to the second quarter of 2021. In the last two quarters of 2021 operational hours returned to pre-COVID levels. Covert car-based operations have remained a proportionally lower contributor to the total hours enforced since the introduction of covert operations.

## crash costs

Willingness to Pay crash costs for use in the economic evaluation were provided by TMR with the crash data (Table 1) in 2021. The post-activation 2020-2021 fixed camera crash distribution by severity and police region and crash urbanisation and the 2020-2021 crash data by sector region and sector urbanisation were used respectively for fixed camera and mobile camera operations, to weight fatal, hospital, medically treated, other injury and no injury costs to produce serious injury (fatal + hospital) and minor injury (minor injury + medical treatment) unit costs (Table 2 and Table 3).

Table 1 2021 Willingness to Pay (WTP) and 2021 Human Crash (HC) Unit Crash Costs by severity

|  |  |
| --- | --- |
|  | WTP |
| Minor Injury | $44,774 |
| Medical Treatment | $137,173 |
| Hospitalisation | $692,719 |
| Fatal | $9,929,821 |

Table 2 2021 WTP Crash costs by severity & crash site urbanisation and police region according to the distribution of Fixed camera crashes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Serious Casualty Crashes | | Minor Injury | All Casualty Crashes |
| Brisbane |  | | $854,773 | $109,673 | $341,754 |
| Central | Urban\* | | $793,122 | $116,252 | $367,188 |
|  | Rural\* | | $793,122 | $113,007 | $357,829 |
| Northern | Urban\* | | $793,122 | $118,056 | $404,141 |
| South Eastern | Urban | | $857,667 | $111,236 | $357,120 |
|  | Rural\* | | $793,122 | $109,279 | $375,482 |
| Southern | Urban\* | | $793,122 | $108,573 | $359,928 |
|  | Rural | | $793,122 | $103,573 | $481,657 |

\*average fatal:serious and fatal:casualty ratios used due to sparse fatality data

Table 3 2021 WTP Crash costs by severity & sector urbanisation and police region according to the distribution of Mobile camera crashes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Serious Casualty Crashes | | Minor Injury | Casualty Crashes |
| Brisbane | Urban | | $856,439 | $111,185 | $396,367 |
|  | Rural | | $1,107,870 | $112,321 | $660,951 |
| Central | Urban | | $942,831 | $109,434 | $549,991 |
|  | Rural | | $1,433,430 | $111,951 | $985,092 |
| Northern | Urban | | $897,162 | $110,825 | $556,192 |
|  | Rural | | $1,628,122 | $113,981 | $1,197,715 |
| South Eastern | Urban | | $907,876 | $108,475 | $434,695 |
|  | Rural | | $1,301,528 | $108,240 | $820,651 |
| Southern | Urban | | $985,116 | $112,670 | $534,920 |
|  | Rural | | $1,364,020 | $111,697 | $963,079 |

Average fatal and hospitalisation (serious casualty) crash costs vary a relatively large amount between police regions due to the different mix of fatal and hospitalisation crashes in each region; the rural regions had a higher rate of fatal crashes per hospitalisation crash. As there were no fatal crashes in a three-year post-camera period at the fixed camera sites in Central, Northern and Southern rural regions, the average ratio of fatal to serious crashes was used in weighting the costs of serious injury crashes in these regions.

# Methods

The evaluation framework used in this study was that developed and described in Newstead et al (2020). Following sections outline the relevant specific details in applying the framework to estimate the crash and economic benefits of the CDOP in 2020 and 2021.

Analysis has considered crashes by severity: serious casualty (fatal and serious crashes combined), minor injury and all casualty crashes in aggregate. Non-injury crashes are not reported beyond 2010 in Queensland and hence cannot be considered in estimating effects of the program in 2020 and 2021. Analysis has focused on the crash and economic effects of CDOP at the state-wide level and within each of the five police regions in Queensland. State-wide savings estimates have been derived by summation of regional savings estimates.

## Evaluation of fixed cdop elements

### Treatment and control selection

A table summarising the treatment and control selection for fixed CDOP elements (RLCs, FSSCs, RLSCs, PtP cameras and trailer cameras) is presented in Section 8.3 of the Appendix. Included in the table is the matching criteria for selecting the control sites. Choice of the matching criteria reflected the availability and quality of information available in the crash data.

For example, matching of the control sites for RLSCs, PtP and FSSC sites by number of lanes, crash history or traffic volume was not attempted due to traffic volume not being reliably available across all road segments and intersections and tight restrictions on number of lanes and crash history being too restrictive in identifying sufficient control areas to maintain adequate statistical power. An intersection identifier was provided, and was used when available to match control sites. Additional analysis using street names and GPS location was undertaken to uniquely identify control intersections for RLC/RLSC sites. Once identified, a pre-period crash history was defined and used to eliminate control intersections with a very different history[[1]](#footnote-1).

Generally, there were insufficient control intersections available to do very specific crash history matching. Traffic volume data, again could not practically be identified for many RLSC and RLC intersections which precluded this factor being used to match control sites. Traffic volume data, although provided for a number of major arterial roads, were not available for all control sections of road. By matching on other road geometry characteristics, speed limits (Table 4), intersection control type (signalisation), road dividedness and by the locality (SLA and similar surrounding SLAs), a sufficiently similar and sizeable set of control crash sites were identified that were likely to broadly represent traffic volume and crash history. To extend the numbers of control sites to enhance statistical power, control crashes for RLSCs were matched by SLA or the distance from the camera.

Control sites for FSSCs were chosen from the same road at least 2km outside the hypothesised zone of camera influence (defined as 1km either side of the camera) and from the same locality (SLA). It was considered unnecessary and impractical to further distinguish by lane number, crash history and crash volume. In addition, road dividedness was not used as a control matching variable due to the complications caused by the varying nature of reporting this variable along the road where the camera was placed. However, speed limit was used in the selection of these controls, but was broadened for five fixed speed camera control sections so that sufficient controls could be found hence providing adequate analysis power. The following gives the camera site number and the speed limit range used for matching controls:

* Site 1011: 60-80km/h
* Site 3003: 90-100km/h
* Site 3004: 60-70km/h

Both treatment and control crashes for fixed spot cameras were excluded from analysis if their location was listed as being on an entry or exit ramp to a motorway.

Table 4 Speed limits (km/h) associated with Fixed Speed Camera locations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Red-Light Speed ID** | Speed limit | **Red-Light Speed ID** | Speed limit |  | **Tunnel ID** | Speed Limit |
| 2001 | 60 |  |  |  | 1003-1006 | 80 |
| 2002 | 80 | 2100 | 70 |  | 1007-1010 | 80 |
| 2003 | 60 | 2101 | 60 |  | 1013-1016 | 80 |
| 2004 | 60 | 2102 | 80 |  |  |  |
| 2005 | 60 | 2103 | 60 |  |  |  |
| 2006 | 60 | 2104 | 60 |  |  |  |
| 2007 | 80 | 2105 | 60 |  |  |  |
| 2010 | 60 | 2106 | 60 |  | **Point-to-Point** | Speed Limit |
| 2011 | 60 | 2107 | 60 |  | Bruce Highway | 110 |
| 2012 | 60 | 2108 | 80 |  |  |  |
| 2014 | 60 | 2109 | 80 |  | Toowoomba Second Crossing | 100 & 90[[2]](#footnote-2) |
| 2015 | 70 |  |  |  |  |  |
| 2016 | 70 |  |  |  | **Fixed Spot ID** | Speed Limit |
| 2017 | 60 |  |  |  |  |  |
| 2018 | 70 |  |  |  | 1002 | 100 |
| 2019 | 60 |  |  |  | 1011 | 70 |
| 2020 | 70 |  |  |  | 1012 | 110 |
| 2021 | 60 |  |  |  | 3001 | 100 |
| 2022 | 60 |  |  |  | 3002 | 60 |
| 2023 | 60 |  |  |  | 3003 | 100 |
| 2024 | 70 |  |  |  | 3004 | 60 |
| 2025 | 60 |  |  |  | 3005 | 60 |
| 2026 | 60 |  |  |  | 3007 | 100 |
| 2027 | 60 |  |  |  | 3008 | 70 |
| 2029 | 70 |  |  |  | 3009 | 100 |
|  |  |  |  |  |  |  |

Control sites for RSCTs used in targeted and roadworks operations were similarly chosen from the same road 4km outside the hypothesised zone of camera influence in Brisbane, Logan, Moreton and Gold Coast locations (defined as 1km either side of the camera) and 10 km in other (rural high speed) locations (defined as 4 km either side of the camera). Lengths of road segments available were found unable to produce sufficient control crashes when trailer enforcement occurred at several closely spaced locations along the same road. This meant that camera locations had to be grouped for the analysis of the trailer cameras on the Warrego Highway (Sites 487901, 487904, 487906, 487907, 487908, 487909, 487912 and 487913), some sections of the Pacific Highway (Sites 387910, 387911, 387913, 387914 and 387915), the Sunshine Motorway (Sites 587901, 587907 and 587908), some sections of the Bruce Highway (Sites 587902, 587903, 587905, 587906, 587909 and 587910). Each of these groups of treatment sites were respectively compared with a single set of control crashes.

Control sites for RSCTs used in school operations were chosen from sections of road with a 40km/hr speed limit within the same locality (SLA).

Direction of travel was not available as a variable in the crash data (since vehicles in a crash can have multiple directions of travel) so control crashes for the PtP average speed cameras had to be allocated on both outbound and inbound sections of divided road. The controls for this segment of road were chosen not by speed or road geometry but by using the lengths of outside of the outermost halo region for the cameras defined as 5km up and downstream of the system end points[[3]](#footnote-3). The control section was equally split between either ends of the PtP site. Distances were measured along the Bruce Highway and the Toowoomba Second Range Crossing using the Google Earth “path” function and GIS mapped camera locations. Crashes were counted north or south of the latitude position (measured to seconds) of the outer control and halo points on the Bruce Highway section and east or west of the longitude position of the outer control and halo points on the Gore Highway (to the East) and the Warrego Highway (to the west) adjunct to the Toowoomba Second Range Crossing. Table 5 gives the map coordinates of the treatment and control sections.

Table 5 Segment Distances and Location of Point-to-Point camera and control segments

|  |  |  |  |
| --- | --- | --- | --- |
| **Position on Bruce Hwy** | **Latitude** | **Longitude** | **Distance (km)** |
| Northern end of Control segment | 26°42’ S | 153°00’ E | 7.2 |
| Northern End of camera Halo | 26°45’ S | 153°03’ E | 5.0 |
| Northern Camera | 26°47’ S | 153°03’ E | 26.8 |
| Southern Camera | 27°01’ S | 152°59’ E | 26.8 |
| Southern End of camera Halo | 27°04’ S | 152°59’ E | 5.0 |
| Southern end of Control segment | 27°08’ S | 152°59’ E | 7.2 |
| **Position on Lindsay Hwy** | **Latitude** | **Longitude** | **Distance (km)** |
| Northern End of camera Halo | 27°41’ S | 153°01’ E | 5.0 |
| Northern Camera | 27°43’ S | 153°01’ E | 8.83 |
| Southern Camera | 27°48’ S | 153°01’ E | 8.83 |
| Southern End of camera Halo | 27°50’ S | 153°01’ E | 5.0 |
| Not analysed in 2022- control n/a |  |  |  |
| **Position on Toowomba 2nd Range Crossing\*\*** | Latitude | Longitude | Distance (km) |
| Western end of Control segment | 27°41’S | 151°43’S | 10.0 |
| Western End of camera Halo\* | 27°37’S | 151°46’S | 2.6 |
| Athol Camera | 27°36’S | 151°47’E |  |
| Wellcamp Camera | 27°33’S | 151°49’E | 6.9 |
| Halo |  |  | 6.1 |
| Charlton Camera | 27°31’S | 151°52’E |  |
| Cranley Camera | 27°31’S | 151°56’E | 7.0 |
| Halo |  |  | 1.7 |
| Harlaxton Camera | 27°31’S | 151°57’E |  |
| Post Office Ridge/ Wilcott Camera | 27°31’S | 152°02’E | 9.5 |
| Eastern End of camera Halo | 27°32’ S | 152°04’ E | 5.0 |
| Eastern end of Control segment | 27°38’ S | 152°10’ E | 10.0 |

\*And Gore Highway to the west and Warrego Highway to the east.

\*Halo is from start of Toowoomba Second Range Crossing to Athol Camera

The *Airport-Link, Legacy Way* and *Clem 7* tunnels had no period without cameras since the cameras were installed before the roads were opened. There were also no suitable feeder roads to use as controls, so the *Southern Cross Way* and *Port of Brisbane Motorway* were chosen as control segments. The crash counts were then analysed with a volume multiplied by distance offset (an offset being a constant term included in the model to represent total traffic travel exposure) to give a comparison of relative crash rates per distance travelled across the treatment and control sections. The *Inner-City Bypass* (ICB) was not chosen as traffic volume data were not available for all years and were recorded in a different manner to the state AADT surveys. Also, the ICB was complicated by having sections with varying speed limits and multiple exit/entry points. Crash counts, volume data, volume location and distances measured using Google Maps are shown in Table 6.

Table 6 Tunnel cameras, treatment and control road lengths and traffic volume

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Road** | **Position of Volume Data** | **Average Annual Daily Traffic** | | | | | | | | | **Distance (km)** |
| **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** |  |
| Clem 7 | U12A North of Ipswich Rd O'pass | 124,435 | 125,445 | 126,115 | 127,310 | 129,303 | 133,141 | 132,473 | 118,117 | 118,117 | 6.84 |
| Airport-Link | 400m East of Sandgate Rd | 43,272 | 45,946 | 63,881 | 69,580 | 53,746 | 59,019 | 63,989 | 41,279 | 41,279 | 6.70 |
| Legacy Way | Western Arterial road S of Mt Cootha Roundabout |  |  | 68,526 | 76,545 | 54,021 | 51,036 | 51,019 | 47,593 | 47,593 | 4.6 |
| Southern Cross Way | 913 Gateway Mwy Sth of Toombul Rd O'pass | 41,351 | 41,588 | 43,516 | 44,694 | 45,567 | 46,483 | 45,947 | 45,947 | 45,947 | 7.15 |
| Port of Brisbane Mwy | WiM site Lytton | 12,164 | 12,834 | 13,161 | 13,161 | 10,860 | 10,860 | 10,860 | 10,860 | 10,860 | 7.07 |

The volume data for the *Clem7* was collected just prior to the exit for the southern start of the *Clem7* tunnel on the South Eastern Arterial (M3). The *Airport-Link* volume data was collected just east of the tunnel, on the same road. Table 6 shows that the annual reported volume data sometimes is no different from one year to the next. This seems unlikely although no explanation for this consistency was available. If volume surveys were not conducted in subsequent years with repeat traffic volumes, this analysis may bias the estimated treatment effect due to inaccurate estimation of control traffic volumes (hence inaccurate estimation of exposure corrected crash rate in the control). Crash counts in each tunnel are summarised in Table 7

Table 7 Crash counts for treatment and control segments in the cross-sectional analysis of the Clem 7 and Airport-Link tunnels

|  |  |  |  |
| --- | --- | --- | --- |
| **Road** | **Serious Casualty** | **Minor Injury** | **Casualty** |
| **Treatment** |  |  |  |
| Legacy Way (2015-2021) | 2 | 5 | 7 |
| Clem 7 (2010-2021) | 6 | 15 | 21 |
| Airport-Link (2012-2021) | 10 | 14 | 24 |
| **Control** (2010-2021) |  |  |  |
| Southern Cross Way | 28 | 20 | 48 |
| Port of Brisbane Mwy | 9 | 12 | 21 |

### Analysis period

The analysis periods for each camera treatment and control pair were defined by the ‘go live’ dates for each fixed camera. For consistency, dates for the installation of signage were not used in the analysis because they were only available for the PtP cameras, four digital fixed speed cameras and the RLSCs. However, due to the RLSCs being previously RLCs, sign installation dates were not relevant for most RLSCs. In addition, the fixed speed camera crash data were too few to attempt a two point after period effect (i.e. measuring the crash effects after camera placement but before activation but with signage, and then after activation). Analysis *before* periods were from the start of available data (01/01/1992) to the point of camera or signage installation as indicated by the ‘Go-live’ date, whilst analysis after periods were the periods from installation when the cameras were ‘live’, to the end of available data or decommissioning.

For RSCTs, the analysis periods were defined by camera activity at a location. A location could have just one camera (a single unique site number) or could have a cluster of cameras in operation over the 2020 to 2021 period. When a trailer camera was in operation (including intermittent dormant days of periods less than a week), plus one week after the end of the operation, the trailer camera was considered active at a location. At all other times, from the start of 1992, to the end of 2021 or to the point where all cameras used at a location were decommissioned, when there were no operational cameras at a location, the location was considered not active. The regression analysis structure for RSCTs differed from fixed cameras in the analysis period variable only: instead of using an indicator of before and after, an indicator of active and not active was used.

### Analysis by crash type

There was sufficient statistical power to analyse red-light (RL) and red-light speed (RLS) cameras both on crashes overall and by broad crash type (targeted – right turn against or cross traffic crashes - or rear-end). For the crash type analyses, it was necessary to exclude sites from analyses where the treatment or control sites had no before activation crash history of the specific crash type. Exclusions were to ensure stability of the regression analysis.

### Matching treatment and control crash history

Every attempt was made to balance both control site proximity to the camera site and the size of the control crash group. However, in order to preserve the integrity of the crash location, so that the traffic volume and local events were controlled, the control crash population did not always meet the preferred size. Newstead & Cameron (2012) suggested that the pre-activation control crash history should be within the two standard error range of treatment crashes indicating statistical compatibility. From Section 8.4 of the Appendix, which presents the crash history at the trailer and fixed camera treatment and control sites, it can be seen that although this condition has not been universally met, control site crash counts are generally at least of a similar magnitude to those of the treatment sites.

### Crash savings and community cost savings for the trailer and fixed camera program

Analysis of camera effectiveness resulted in an estimated net percentage crash saving at camera sites relative to the control site. Percentage crash savings were converted to absolute crash savings and subsequently into community cost savings using the following methods.

* The average annual crash counts at fixed camera treatment sites, after the camera went live, and at trailer sites when the cameras were active, were first calculated by camera type, police region (and rural/urban status) and severity for the years 2020 to 2021.
* Absolute annual crash savings for each crash severity, police region (and speed category) and fixed speed camera type were determined from the application of crash reduction percentages (for each crash severity), determined from regression analysis, to the average annual crash counts. Regression estimates of camera effectiveness were produced for all fixed cameras combined on average. The exceptions were for trailer cameras and for tunnel cameras. Trailer cameras were analysed in an on/off rather than before/after manner and tunnel cameras had no pre-camera periods. These properties meant that neither could be analysed within the treatment-control, before-after quasi-experimental design.
* Average annual absolute crash reductions were converted into community cost savings according to the process illustrated in the CDOP evaluation framework (Newstead & Cameron, 2012) by multiplying the estimated absolute crash savings at the crash severity level being considered by the per unit cost of each crash (Table 2) to derive the community cost savings related to the crash reductions.

## Evaluation of the mobile speed camera program

Application of the evaluation framework of Newstead et al (2020) for the mobile camera program required the specification of a number of details of the framework including: the final definition of treatment and control areas, definition of the analysis strata, selection of the periodicity for the analysis time series data and decisions about the measure of speed camera program delivery measures that would be used as predictors in the analysis models. Each of these aspects is described in the following sections along with details about the interpretation of the analysis model outputs and the conversion of these to estimate absolute crash savings and crash cost savings both by region and for Queensland overall.

### Treatment and control area definition and analysis strata

As illustrated in Figure 1, Queensland is geographically defined into segments for the identification of areas to enforce with mobile speed cameras. Within each sector chosen for enforcement, individual sites for camera placement have been identified. Through matching with the mobile speed camera operations data, sites and hence sectors in which a mobile speed camera session had taken place at some time since January 1999 were identified. The number of mobile speed camera operations by type of operation in each month in each sector were identified through linking via the site identifiers within each sector.

Police-reported crashes in Queensland were also geographically linked to sectors. Every reported crash was linked to a sector unless locational details were missing which was the case for only a small number of crashes (less than 20 crashes). Furthermore, 4% of casualty crashes in the data were excluded for being within the zone of influence of a fixed camera. A total of 282,610 casualty crashes were included in the analysis from January 1, 1999 to December 2021, the period for which mobile speed camera operations data were available.

Treatment areas were defined as those sectors in which at least one mobile speed camera operation (of any duration) had taken place during the study period. Control areas were defined as those sectors in which no mobile speed camera operations had taken place over the study period. Treatment and control sectors were then aggregated for analysis by police region (Brisbane, Central, Northern, South-Eastern and Southern), and by urban and rural status according to the sector in which the crash fell (defined by TMR for the 2018/2019 analysis). Aggregation in this way allowed estimation of program effects within each region whist broadly controlling for confounding factors which differ by region and level of urbanisation. The resulting analysis stratification defined ten treatment and control pairs of crash time series data. Separate sets of treatment and control data pairs were formed for each crash severity level considered, being: all casualty crashes and fatal and serious injury crashes combined. There was insufficient data to consider fatal crashes alone and non-injury crashes have not been reported in Queensland after 2010.

### Time series periodicity

For each regression analysis by crash severity, data were aggregated into a time series structure within each police region, urban / rural split, sector and treatment and control pair having its own time series of data for analysis. To ensure a viable analysis, a periodicity for the data analysis needed to be chosen that had two properties. First, it had to display significant time to time variation in the mobile speed camera operations within each treatment time series to give analytical power in establishing a relationship between variation in crashes and variation in camera operations. Second, it needed to have sufficient number of crashes within each time period, stratum and treatment and control pair to also ensure sufficient analysis power. Following Newstead et al (2020) it was decided that quarter of a year was the most appropriate periodicity on which to form the analysis time series to ensure both criteria were met.

### Measures of mobile speed camera operations considered

As described in Section 2.2.4, mobile speed camera operations were classified in the operations data provided into six specific types: overt car-based, covert car-based, overt portable, overt LTI, covert LTI and motorcycle LTI/portable. Also, as noted in Section 2.2.4, LTI camera operations replaced portable operations, essentially presenting the same hand-held mode of roadside operation. Furthermore, although a small proportion of LTI operations were designated as covert, it is unlikely that these operations are truly covert. In consultation with TMR project staff, it was decided to treat all portable and LTI camera operations in aggregate in the analysis resulting in three different types of camera operation being included in the analysis model: overt car-based, covert car-based and total portable/LTI.

Significant quarterly variation in the number of hours of deployment of each camera type was observed over the study period, as illustrated in **Error! Reference source not found.**. Furthermore, the pattern of quarterly variation differed significantly between analysis strata as did the balance between types of camera use. Time series of quarterly hours of deployment of each of the three camera types in each of the analysis strata were calculated from the operations data provided for each quarter over the study period. These were included as predictors in each analysis model as described by Equation 3 in section 3.3.2 of Newstead et al (2020).

### Analysis output and conversion to crash and crash cost savings

Key output from the analysis model are the parameter estimates of *A, B* and *C* from Equation 3 of Newstead et al (2020). These parameters give the relationship between the number of hours of enforcement by each speed camera type in each stratum and the observed crash count in each stratum. The exponent of each of these parameters (*exp(A), exp(B) and exp(C)*) gives the proportionate change in expected crash outcome per hour change in enforcement in each stratum and quarter.

To estimate the absolute crash saving attributable to the mobile speed camera program in each stratum and quarter, the predicted crash count in each stratum at the level of enforcement observed in that stratum *s* and time period *t* was compared to that predicted if no camera enforcement of any type had occurred in that time period (i.e. *Osgt, Vsgt* and *Lsgt* = 0). The crash saving (δst) in stratum *s* and time period *t* is then given by Equation 1.

… (Equation 1)

Total crash savings per year, within each stratum and across Queensland as a whole were then calculated by aggregating individual savings across the appropriate time periods (e.g. quarters in the year) and strata.

Absolute crash reductions were converted into community cost savings by multiplying the estimated absolute crash savings at the crash severity level being considered by the unit cost of each crash to derive the cost savings related to the crash reductions. Savings were calculated by police region, crash severity and crash year.

## combined estimate of state-wide cdop crash effects

The final step of the evaluation of the CDOP was to combine estimates of the effectiveness of individual program elements to arrive at aggregate effectiveness estimates both within specific police regions as well as across the whole of Queensland. This process involved consideration of the crash population covered by each mode of enforcement along with the estimated effectiveness of each camera type. The methodology used to combine state-wide CDOP effects is also described in Newstead et al (2020).

In this report average annual crash savings were calculated by crash severity, police region and camera type groupings: RLCs, RLSCs, mobile speed cameras, tunnel fixed cameras, all other fixed speed cameras (including average speed cameras) and RSCTs. The state–wide CDOP annual absolute crash reductions and average annual crash cost savings were determined through regional summation over tunnel, other fixed (combined), trailer camera and mobile camera type. The state-wide CDOP average crash reduction was weighted using the average annual *post-activation* base period crash counts. Savings were estimated separately for 2020 and 2021 calendar years.

# Results

## Red-light cameras (RLCs)

Table 8 presents a summary of the estimated crash effects associated with CDOP RLCs by region and crash severity grouping. The table presents the estimated relative risk (crash risk at enforced sites relative to unenforced sites), 95% statistical confidence limit on the estimate and statistical significance probability for each crash severity and region. Results of homogeneity tests indicated that there was no statistical evidence that the crash effects associated with the RLC operation differed between police regions for minor injury, casualty or serious injury crashes. With no statistically significant differences in estimates between police regions, average regional state crash reductions associated with the different severities (Table 8) do not need to be used in place of the state average in the estimation of total savings by region.

Table 8 Estimated crash risks associated with the red-light camera sites relative to sites without red-light cameras (all urban sites)

|  |  |  |  |
| --- | --- | --- | --- |
| **Estimate**  **(95% CI)**  **Significance** | **Serious Casualty** | **Minor Injury** | **All Casualty**† |
| All | 0.88 | 0.89 | 0.90 |
|  | (0.76,1.03) | (0.81,0.98) | (0.82,0.98) |
|  | 0.12 | 0.02 | 0.02 |
| Brisbane | 0.83 | 0.90 | 0.90 |
|  | (0.67,1.03) | (0.79,1.02) | (0.80,1.01) |
|  | 0.08 | 0.11 | 0.07 |
| Central | 0.83 | 0.95 | 1.01 |
|  | (0.37,1.84) | (0.78,1.16) | (0.82,1.24) |
|  | 0.65 | 0.63 | 0.95 |
| Northern | 1.42 | 0.95 | 1.10 |
|  | (0.70,2.88) | (0.61,1.49) | (0.76,1.59) |
|  | 0.33 | 0.84 | 0.60 |
| South Eastern | 0.74 | 0.74 | 0.75 |
|  | (0.49,1.11) | (0.58,0.95) | (0.60,0.94) |
|  | 0.14 | 0.02 | 0.01 |
| Southern | 0.50 | 0.96 | 0.80 |
|  | (0.25,1.00) | (0.62,1.49) | (0.55,1.16) |
|  | 0.05 | 0.86 | 0.23 |

† Estimated from an all casualty crash model

Annual crashes in the post-camera period, identified within the defined halo of influence of the RLC (<100m from camera and recorded as at a signalised intersection), were tabled by severity and police region for 2020 to 2021. The average annual count (rounded to the nearest integer) over the period is given in Table 9 as a measure of the crash population covered by this camera type. Overall crash reduction estimates by severity were applied to the annual counts to produce the absolute crash savings per year given in Table 10. These were then costed by the WTP approach, with results given in Table 11.

Table 9 Average annual post-activation red-light camera treatment crash counts by severity and police region

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** | **All Casualty** |
| All\* | 71 | 141 | 211 |
| Brisbane | 36 | 80 | 115 |
| Central | 12 | 16 | 27 |
| Northern | 6 | 12 | 17 |
| South Eastern | 11 | 25 | 36 |
| Southern | 7 | 10 | 17 |

\*sum of regions, rounding applies

Table 10 Average annual absolute crash savings associated with red-light cameras, by severity and police region

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** | **All Casualty†** |
| All\* | 9 | 17 | 24 |
| Brisbane | 5 | 10 | 13 |
| Central | 2 | 2 | 3 |
| Northern | 1 | 1 | 2 |
| South Eastern | 1 | 3 | 4 |
| Southern | 1 | 1 | 2 |

† Estimated from an all casualty crash model

\*sum of regions, rounding applies

The casualty crash reductions of 18% (Table 8) associated with RLCs translated to the average annual prevention of 24 casualty crashes, 9 of which were serious, saving society about $9M per year using WTP crash cost valuation.

Table 11 Average annual savings associated with red-light cameras, by severity and police region: Willingness to Pay approach

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** | **Casualty**† |
| All\* | $7,830,957 | $1,891,504 | $8,569,622 |
| Brisbane | $4,040,317 | $1,054,796 | $4,508,545 |
| Central | $1,214,435 | $217,989 | $1,137,306 |
| Northern | $580,817 | $164,243 | $788,148 |
| South Eastern | $1,256,168 | $329,696 | $1,454,345 |
| Southern | $739,221 | $124,781 | $681,278 |
|  |  |  |  |

\*Sum of regions, rounding errors apply

† All Casualty is modelled separately and is not the sum of serious and minor.

## Red-light speed cameras (RLSCs)

The intersection sites of twenty[[4]](#footnote-4) of the evaluated 35 RLSCs previously housed RLCs. For these cameras, the period for which there was only an RLC period was evaluated with the RLCs in the previous section. The crash reduction associated with a RLSC upgrade period was evaluated and reported with the results in this section. For these twenty-one cameras, the before treatment period is defined as the period where the RLC was installed and the post-period the time from which the upgraded RLSC was installed.

Red light cameras were not previously installed at fifteen RLSC sites (2002 & 2015-2024, 2026-2027 and 2108-2109). The effect of these RLSCs was assessed against a no-camera pre-period.

Defining pre-RLSC periods in these ways produced pre-periods of at least 6.4 years and operational periods of 2.5 to 10.4 years. By analysing the RLCs and RLSCs in this way, all effects could be associated with the camera of influence, be compared with a more immediate prior period, and be directly combined without duplication or overlap.

For both RLSC placed at RLC sites and RLSC placed at sites previously without a camera, tests of homogeneity showed no statistical evidence of a regional difference, so as with the RLC analysis, state averages were used to estimate savings. The relative risk analyses were carried out for all RLSCs. Results of these analyses are found in Table 12.

Table 12 Estimated relative crash risks, (95% confidence interval and p-value) associated with red-light speed camera installation (Using all sites uniquely within the combined fixed camera models): All urban locations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Estimate** | **Serious Casualty** | | **Minor Injury** | **All Casualty**† |
| **(95% CI)** |
| **Significance** |
| **Referenced to no-camera period** | | | | |
| Combined: 2002 & 2015-2024, 2026-2027 and 2108-2109 | 0.99 | | 1.58 | 1.36 |
| (0.69,1.41) | | (1.23,2.04) | (1.11,1.67) |
| 0.94 | | 0.0004 | 0.004 |
| Brisbane | 0.74 | | 1.40 | 1.17 |
| (2002, 2016, 2027) | (0.41,1.34) | | (0.99,1.98) | (0.87,1.58) |
|  | 0.33 | | 0.06 | 0.29 |
| Central‡ |  | | 3.17 | 1.83 |
| (2020, 2023) |  | | (0.98,10.21) | (0.74,4.51) |
|  |  | | 0.05 | 0.19 |
| Northern | 1.07 | | 2.06 | 1.53 |
| (2018, 2019) | (0.49,2.35) | | (0.84,5.03) | (0.86,2.72) |
|  | 0.86 | | 0.11 | 0.15 |
| South Eastern | 1.80 | | 1.60 | 1.68 |
| (2015, 2108) | (0.73,4.47) | | (0.78,3.29) | (0.96,2.95) |
|  | 0.20 | | 0.20 | 0.07 |
| Southern | 1.04 | | 1.68 | 1.44 |
| (2017, 2021, 2022, 2024,2026, 2109) | (0.50,2.18) | | (0.97,2.90) | (0.93,2.22) |
| 0.91 | | 0.06 | 0.10 |
| **Referenced to red-light camera period** | | | | |
| Combined: 2001,2003-2007,2010-2012, | | 0.87 | 0.85 | 0.84 |
| 2014, 2025, 2028,2029,2100, | | (0.64,1.17) | (0.68,1.05) | (0.71,1.00) |
| 2101,2102,2103,2104, 2105, 2106, 2107 | | 0.35 | 0.12 | 0.06 |
| Brisbane | | 1.17 | 0.68 | 0.81 |
| (2001, 2025, | | (0.68,2.04) | (0.45,1.03) | (0.58,1.12) |
| 2029,2104,2106) | | 0.57 | 0.07 | 0.20 |
| Central | 0.75 | | 1.20 | 1.03 |
| (2005, 2007, 2103) | (0.15,3.76) | | (0.59,2.44) | (0.61,1.75) |
|  | 0.73 | | 0.62 | 0.91 |
| Northern | 0.53 | | 0.72 | 0.63 |
| (2004, 2006) | (0.25,1.09) | | (0.42,1.24) | (0.41,0.97) |
|  | 0.09 | | 0.24 | 0.04 |
| South Eastern | 1.00 | | 0.88 | 0.91 |
| (2003, 2028,2100, 2101, | (0.60,1.66) | | (0.63,1.23) | (0.69,1.20) |
| 2102, 2107) | 0.99 | | 0.45 | 0.51 |
| Southern | 0.48 | | 1.61 | 1.05 |
| (2010,2011,2012,2014, | (0.13,1.72) | | (0.69,3.80) | (0.53,2.08) |
| 2105) | 0.26 | | 0.27 | 0.89 |

‡ short operation period (of 2.5 years for 2020 and of 3.0 years for 2023) prevented a s regression coefficient for serious casualty in Central.

† All Casualty is modelled separately and is not the sum of serious and minor.

Reductions in crashes of all severity were associated with upgrades from RLC to RLSC. However, none of these were statistically significant, indicating that further follow-up of additional upgrades or for a longer post implementation period would be required to produce robust evidence on the road safety benefits of RLC upgrades. All of the upgraded RLSCs were operating for at least 2.9 years within the study period (1992 to 2021).

Estimates of the crash effects of RLC to RLSC upgrades against the time period prior to RLC installation were generally uninformative with none of the serious casualty or all casualty crash estimates achieving statistical significance (due to short or unavailable ‘before camera’ periods. Consequently, the evaluation was only able to provide evidence on the effectiveness of RLC to RLSC upgrades, and not a measure of the total effect of a RLSC installation from an unenforced intersection for these upgraded sites.

New RLSC installations to locations without a previous RLC were associated with a significant increase in minor injury crashes. Reductions were estimated for serious casualty crashes overall and for Brisbane, however these were not statistically significant. Average casualty relative risk estimates are heavily influenced by minor injury crashes, hence the significant increases in overall casualty crashes associated with RLSC at new camera installations.

Results of homogeneity tests indicated that there was no statistical evidence that the crash effects associated with the upgrade of either RLC to RLSC, or no camera to RLSC, differed between regions at any level of crash severity. This indicates that the associated average crash reductions estimated across all sites could be considered to apply equally to all regions. Consequently, the overall average results were used in estimating absolute crash savings and their associated community costs.

Average annual crashes identified within the defined halo of influence of a RLSC (<100m from camera and recorded as at a signalised intersection) by severity and police region across the period of focus, 2020 to 2021, are given in Table 13. Average crash reductions associated with intersection upgrades of RLC or no camera, to RLSC, by severity were applied to the annual counts to produce the absolute crash savings per year given in the main results. Table 14 shows the average annual crash savings estimated across 2020 to 2021 which were then costed by the WTP approach with results given in Table 15.

Table 13 Average annual post-activation red-light speed camera treatment crash counts by severity and police region

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** | **Casualty** |
| All\* | 32 | 52 | 84 |
| Brisbane | 11 | 18 | 29 |
| Central | 3 | 4 | 7 |
| Northern | 6 | 3 | 9 |
| South Eastern | 8 | 17 | 25 |
| Southern | 5 | 11 | 16 |

\* Sum of regions, rounding error applies

Table 14 Average annual absolute crash savings associated with red-light speed cameras, by severity and police region

|  |  |  |
| --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** |
| All\* | 3 | -3 |
| Brisbane | 1 | -2 |
| Central | 0 | -1 |
| Northern | 0 | 0 |
| South Eastern | 1 | 1 |
| Southern | 0 | -1 |

\* Sum of regions

† Estimated from an all casualty crash model

Table 15 Average annual savings associated with red-light cameras, by severity and police region

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Willingness to pay** | | |
|  | **Serious Casualty** | **Minor Injury** | **All Casualty** |
| All\* | $2,123,591 | -$321,335 | $1,802,256 |
| Brisbane | $783,411 | -$182,820 | $600,591 |
| Central | $194,152 | -$75,000 | $119,152 |
| Northern | $172,607 | -$32,799 | $139,808 |
| South Eastern | $695,781 | $89,774 | $785,555 |
| Southern | $277,640 | -$120,489 | $157,151 |

\*sum of regions, rounding errors apply

† Sum of serious casualty and minor injury cost savings

### Crash type analysis for red-light (RLCs) and red-light speed cameras (RLSCs)

After the exclusion from analysis of sites with zero counts of at least one of the three crash types analysed (rear-end, right-through and other) in the pre-camera installation period, regression analysis was able to produce crash reduction estimates disaggregated by crash type. Right-through crashes were crashes at the intersection where one vehicle was turning right, or approaching at a right angle, and would cross the path of another vehicle travelling straight through the intersection. These crashes are typically the target of red-light cameras since they result from a signal breach.

Figure 3 displays the estimated relative risks with 95% confidence intervals for the RLCs and RLSCs referenced to a period of no-camera, as well as for the RLSCs, referenced to a period of RLC. From this figure, some trends are evident:

* There was no clear evidence that either RLC or RLSC upgrades were associated with a statistically significant change in *rear-end* serious injury crashes, however, there was statistical evidence that both RLSCs (new, and upgraded combined) and RLCs were associated with around a 20% increase in casualty and minor injury *rear-end* crashes (p = 0.001, combined cameras casualty).
* There was statistical evidence that both RLCs and RLSCs were associated with around 30% reductions of *right-through* crashes of all severities. (p < 0.0001, combined cameras casualty, p= 0.03 combined cameras serious casualty, p= 0.003 combined cameras minor injury crashes).

Data further disaggregated into regions and urbanisation proved too unstable for regression analysis and was considered not warranted based on the assessed homogeneity of the overall crash effect estimates.

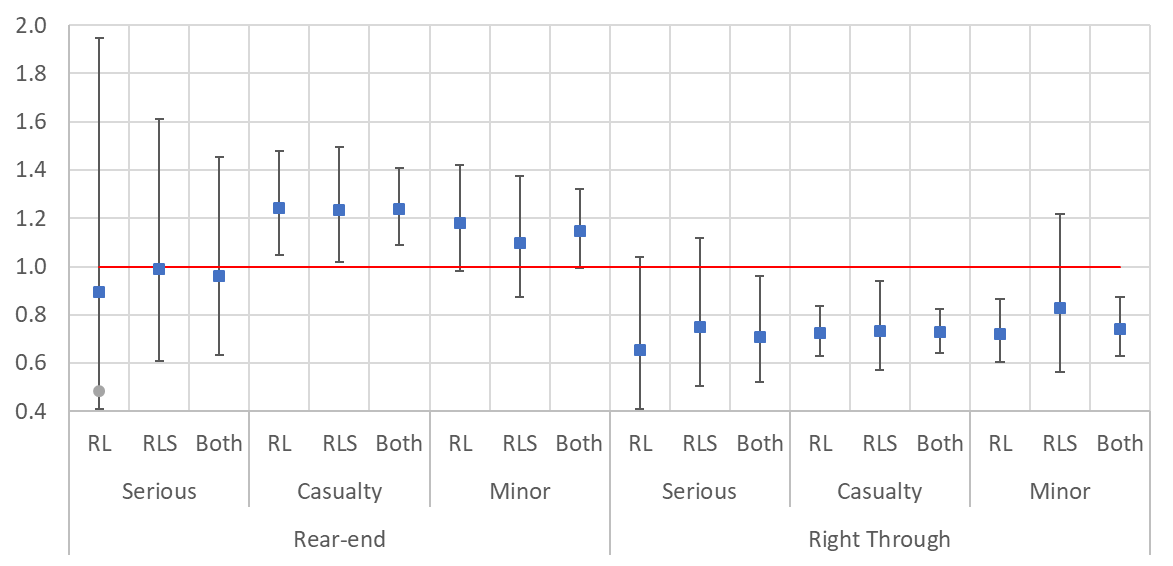


Figure 3 State-wide relative risk estimates by crash type for fixed red-light and red-light speed cameras

A meta-analysis by Erke (2009) found a 40% increase in rear-end crashes associated with RLCs. This study supported this finding, although with lesser percentage increases, for both red-light and red-light speed cameras.

Research by MUARC (Budd, Scully and Newstead, 2011) found RLSCs to be associated with a 44% reduction in right-through casualty crashes. Results in this evaluation found reductions in *right-through* crashes associated with RLSC of

* 27% (95% CI: 6% to 43%, p=0.01) for casualty crashes;
* 25% (95% CI: -12% to 50%, p=0.16) for fatal and serious injury crashes and
* 17% (95% CI: -22% to 44%, p= 0.34) for minor injury crashes.

and with RLCs of

* 27% (95% CI: 16% to 37%, p<0.0001) for casualty crashes;
* 35% (95% CI: -4% to 59%, p=0.07) for fatal and serious injury crashes; and
* 28% (95% CI: 13% to 40%, p= 0.0004) for minor injury crashes.

## Fixed Speed Cameras

The estimated effectiveness of fixed speed cameras is presented in three groups: the effects of the PtP speed camera systems (Bruce Highway and Toowoomba Bypass), the combined effects of the tunnel speed cameras (sites 1003 to 1010 and 1013 to 1016) and by region and overall effects of all other FSSCs at non-tunnel mid-block sites (sites 1002, 1011, 1012 and 3001 to 3005 and 3007 to 3009). Table16 and Table 17 present a summary of the fixed speed camera effectiveness estimates. Statistically significant crash reductions were only associated with the PtP and the tunnel speed cameras. Other fixed spot speed cameras were associated with significant increases in serious casualty and all casualty crashes.

This analysis was evaluated with two fewer FSSCs than analysed previously (due to decommissioning) and the crashes in the proximity of the trailer speed cameras further depleted control crashes used in the fixed camera analyses. This left the estimates subjected to greater variation than in previous analyses. It is also possible that the chosen controls were unable to sufficiently adjust for environmental changes over time. This would happen if changes to traffic flow, traffic volume and infrastructure over time did not have similar effects on both the treatment and control locations. An observed increase in crash risks associated with FSSCs will arise when changes to the environment in the control sections had a greater effect on reducing crash risk than FSSCs did. Further investigation to explore this possibility is warranted. However, if the effect is real and not a result of aberrant variation nor of ineffective control, it indicates that, in the periods after the FSSCs began operations, the crash risks rose more within the FSSCs zones of influence than further along the roadways leading to them. This conclusion highlights the need for further in-depth analysis of crashes at these sites beyond what is possible in the evaluation framework utilised for this study.

The effects of the Bruce Highway PtP incorporated the effects of trailer cameras operational within their zones of influence. In this 2020-2021 evaluation, the additional years of observation have enabled robust and strongly significant results for minor injury and casualty crash reductions of 43% and 35% respectively, which are similar and not statistically different to the statistically significant results of the previous analysis. The South Eastern region PtP system was decommissioned prior to 2020, so its effects did not contribute to the savings attributed to PtP cameras for this analysis. Analysis of the Toowoomba PtP was not able to produce robust estimates due to the very short 3-month after implementation time period available for the study. However, average P2P effects were applied to the few post-camera crashes at the Toowoomba PtP assuming equivalent crash reductions to the Bruce Hwy site and contribute to the estimated 2020-2021 PtP savings. Future evaluations need to accommodate the lack of pre-implementation crash history of this length of road resulting from the system being installed onto a newly build road length. Consideration of an approach similar to that used for the tunnel camera evaluations may be necessary for the future Toowoomba PtP evaluations when sufficient post-implementation period allows for robust assessment.

Table 16 Estimated relative crash risks associated with fixed spot speed cameras (excluding point-to-point and tunnel cameras)

|  |  |  |  |
| --- | --- | --- | --- |
| **Estimate**  **(95% CI)**  **Significance** | **Serious Casualty** | **Minor Injury** | **All Casualty**† |
| All | 1.29 | 1.06 | 1.13 |
|  | (1.08,1.55) | (0.93,1.21) | (1.01,1.25) |
|  | 0.01 | 0.40 | 0.03 |
| Brisbane | 1.49 | 0.94 | 1.08 |
| *(3002,3003)* | (1.04,2.15) | (0.74,1.19) | (0.88,1.31) |
|  | 0.03 | 0.62 | 0.47 |
| Central Urban | 0.92 | 1.04 | 0.98 |
| (1011,3008) | (0.54,1.58) | (0.71,1.51) | (0.72,1.33) |
|  | 0.77 | 0.85 | 0.88 |
| Central Rural | 1.02 | 0.70 | 0.80 |
| (3009) | (0.51,2.04) | (0.37,1.33) | (0.50,1.27) |
|  | 0.96 | 0.27 | 0.35 |
| South Eastern Urban | 1.33 | 1.20 | 1.23 |
| (3004, 3005) | (0.92,1.94) | (0.91,1.57) | (0.99,1.54) |
|  | 0.13 | 0.20 | 0.06 |
| South Eastern Rural | 1.34 | 1.19 | 1.24 |
| (1002, 1012) | (0.93,1.93) | (0.91,1.56) | (1.00,1.54) |
|  | 0.12 | 0.20 | 0.05 |
| Southern Rural | 1.30 | 1.04 | 1.16 |
| (3001, 3007) | (0.73,2.34) | (0.62,1.72) | (0.80,1.70) |
|  | 0.37 | 0.89 | 0.43 |

† Estimated from an all casualty crash model

Estimated crash risks at Clem 7 and Airport-Link camera sites were relative to the chosen above ground freeway comparison routes: Port of Brisbane Motorway and Southern Cross Way and were determined from *Cross-sectional Treatment-Control* analysis controlling for traffic volumes. A statistically significant reduction in risk was associated with the tunnel cameras. To some degree these estimates should be treated with caution because the control roads, although adjusted for traffic volume and distance, were not tunnels. However, the results do indicate that the road safety environment created in the tunnels whether partially or wholly through the use of fixed speed cameras, is much safer than that observed at comparable above ground motorways.

In this analysis, some potential for mis-identification of crashes on the Southern Cross Way and Gateway Motorway was possible through comparing the GPS co-ordinates for a crash compared to the listed road name. The source of this issue is likely to have arisen from name changes to these roads over time as new overpasses and bypasses were built, replacing the original Gateway Arterial road sections and roundabouts. For this analysis (and the previous study), the motorway matching the GPS co-ordinate for the crash was used to identify motorway crashes instead of using street name.

Table 17 Estimated relative crash risks associated with point-to-point spot and average speed, and tunnel fixed speed cameras (*relative risk estimate, 95% C.I., statistical significance*)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | |  | | **Serious Casualty** | | **Minor Injury** | | **All Casualty**† |
| **Tunnel** | | | | |  | |  | |  | |  |
|  | | | | | | *Both* | | 0.23 | 0.33 | | 0.26 |
|  | | | | |  | | | (0.09, 0.57) | (0.14, 0.77) | | (0.13, 0.54) |
|  | | | | |  | | | 0.002 | 0.01 | | 0.0003 |
|  | | | | | | *Clem 7* | | 0.08 | 0.22 | | 0.14 |
|  | | | | |  | | | (0.03, 0.20) | (0.11, 0.45) | | (0.08, 0.26) |
|  | | | | |  | | | <.0001 | <.0001 | | <.0001 |
|  | | | | | | *Airport-Link* | | 0.38 | 0.65 | | 0.47 |
|  | | | |  | | | | (0.18, 0.77) | (0.34, 1.25) | | (0.25, 0.88) |
|  | | | | |  | | | 0.007 | 0.20 | | 0.02 |
|  | | | | | | Legacy Way | | 0.14 | 0.38 | | 0.24 |
|  | | | | | |  | | (0.03, 0.69) | (0.1, 1.51) | | (0.08, 0.75) |
|  | | | | | |  | | 0.02 | 0.17 | | 0.01 |
| **Point-to-Point** | | | | | | | |  | |  |  |
|  | *All PtP* | | | | | | | 0.81 | | 0.67 | 0.72 |
|  | | |  | | | | | (0.60,1.09) | | (0.52,0.86) | (0.60,0.88) |
|  | |  | | | | | | 0.16 | | 0.002 | 0.001 |
|  | *Central*  *(Bruce Hwy)* | | | | | | | 0.77 | | 0.57 | 0.65 |
| (0.55,1.08) | | (0.42,0.76) | (0.52,0.81) |
|  | |  | | | | | | 0.12 | | 0.0002 | 0.0001 |
|  | *South Eastern* | | | | | | | 0.88 | | 1.05 | 0.97 |
|  | *(Mt Lindsay Hwy)* | | | | | | | (0.44,1.76) | | (0.65,1.71) | (0.65,1.43) |
|  | *to decommissioning* | | | | | | | 0.72 | | 0.83 | 0.86 |
|  | *Southern*  *(Toowoomba)* | | | | | | | 13.00 | |  | 17.87 |
| (0.72,235) | |  | (1.02,312.69) |
| 0.08 | |  | 0.05 |

† Estimated from an all casualty crash model

Annual crashes identified within the defined halo of influence of a fixed speed camera (≤1000m in either direction on the same road) were tabled by severity and police region for 2020 to 2021. The average annual count over the period is given in Table 18 as a measure of the crash population covered by this camera type. Note that the crash reductions by severity were applied to the actual annual counts to produce the absolute crash savings per year given in the main results. Table 19 shows the average annual saving across 2020 to 2021 which were then costed by the WTP approach with results given in Table 20. Negative values in the table indicate an estimated crash or crash cost increase.

Table 18 Average annual post-activation fixed speed camera treatment crash counts by severity and police region

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** | **Casualty** |
| All Tunnel | 2 | 3 | 4 |
| Point-to-Point | 14 | 25 | 39 |
| *Central R (Bruce Hwy)* | 13 | 25 | 38 |
| *Southern R(Toowoomba)* | 1 | 0 | 1 |
| All other fixed\* | 40 | 72 | 112 |
| *Brisbane* | 7 | 20 | 27 |
| *Central Urban* | 2 | 7 | 9 |
| *Central Rural* | 5 | 7 | 11 |
| *South Eastern Urban* | 9 | 14 | 22 |
| *South Eastern Rural* | 14 | 20 | 34 |
| *Southern Rural* | 5 | 5 | 10 |

\*sum of regions, rounding errors apply

Table 19 Average annual absolute crash savings associated with fixed speed cameras, by severity and police region

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** | **Casualty**† |
| All Tunnel | 5 | 5 | 11 |
| Point-to-Point | 4 | 19 | 20 |
| *Central Rural* | 4 | 19 | 20 |
| *Southern Rural* | 0 | 0 | 0 |
| All other fixed\* | -9 | -4 | -12 |
| *Brisbane* | -2 | -1 | -3 |
| *Central Urban* | 0 | 0 | -1 |
| *Central Rural* | -1 | 0 | -1 |
| *South Eastern Urban* | -2 | -1 | -2 |
| *South Eastern Rural* | -3 | -1 | -4 |
| *Southern Rural* | -1 | 0 | -1 |

\*sum of regions, rounding errors apply. † Estimated from an all casualty crash model

NB: Negative values indicate and estimated crash increase

No evidence in heterogeneity in FSSC effectiveness by Police region was found and the 95% confidence intervals of the three overall estimates fell entirely or almost entirely within the confidence intervals for regional estimates for each severity, so the associated average crash reductions estimated across all FSSC sites could be considered to apply equally to all regions. Consequently, the overall FSSC average results were used in estimating absolute crash savings and their associated community costs.

Table 20 Average annual savings associated with fixed speed cameras, by severity and police region: Willingness to Pay approach

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Serious Casualty** | | **Minor Injury** | **Casualty**† |
| All Tunnel | $4,405,200 | $557,787 | | $3,884,567 |
| Point-to-Point | $3,209,685 | $2,139,614 | | $7,343,530 |
| *Central* | $3,113,777 | $2,139,614 | | $7,251,077 |
| *Southern* | $95,907 | $0 | | $92,452 |
| All other fixed\* | -$7,368,976 | -$430,556 | | -$4,627,596 |
| *Brisbane* | -$1,348,159 | -$116,674 | | -$1,014,457 |
| *Central Urban* | -$268,055 | -$44,395 | | -$349,608 |
| *Central Rural* | -$804,164 | -$40,073 | | -$440,903 |
| *South Eastern Urban* | -$1,642,592 | -$81,925 | | -$880,057 |
| *South Eastern Rural* | -$2,501,843 | -$119,235 | | -$1,430,021 |
| *Southern Rural* | -$804,164 | -$28,252 | | -$512,550 |

\*sum of regions † Estimated from an all casualty crash model

NB: Negative values indicate and estimated crash cost increase (based on statistically non-significant relative risk estimates)

### Homogeneity of fixed camera type and site

As has been reported throughout the results for fixed cameras, analysis was conducted to estimate whether there was statistical evidence to support differing (non-homogeneous) crash effects between different camera types and individual cameras. Analysis is based on a chi-squared test of the difference in model fit between a model estimating average effects across all cameras and a model fitting effects specific to each camera type. A significant result indicated non-homogeneous crash effects associated with different camera types or specific cameras.

Tests of homogeneity of camera and regional crash effects were undertaken for the three injury severity groups across the five fixed camera types: (i) red-light, (ii) red-light speed from no-camera, (iii) red-light speed from RLC, (iv) fixed spot speed and (v) PtP. The tunnel cameras were analysed separately and the PtP analysis consisted only of one system, so were excluded from this study of camera specific homogeneity. Results indicate whether camera effectiveness varies by fixed camera type or police region across all fixed camera crashes and if camera effectiveness at specific sites or within police regions varies within a specific camera type. Because fixed spot cameras operated in both rural and urban (speed zones up to 80 km/hr) zones, homogeneity analysis considered both region and urbanisation for these cameras. The significance values for the tests of homogeneity of camera types are presented in Table 21 with a low significance value indicating non-homogeneous crash effects across cameras. Evaluation of homogeneity for RLSCs have been carried out on the cameras with a no prior camera period, as well as for all RLC to RLSC upgrades. Overall type, site and region analyses did not include trailer cameras.

Table 21 Significance probabilities from tests of homogeneity by injury severity for fixed camera analyses: (*Χ2, d.f.*)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | | **Serious Casualty** | **Minor injury** | **Casualty** | |
|  | |  | | |  |  |  | |
| **Camera Type** | | | |  | 0.01 | <0.0001 | <0.0001 | |
|  | |  | | | (13.15,4) | (26.95,4) | (31.25,4) | |
| **Camera sites** | | | |  | <0.0001\*\* | <0.0001‡‡ | <0.0001 | |
|  | |  | | | (198.05,95) | (229.8,98) | (290.65,99) | |
| Red-Light † | |  | | | <0.0001 | 0.00002 | <0.0001 | |
|  |  | | | | (113.32,52) | (104.37,52) | (129.96,52) | |
| Red-Light Speed † | *All from no camera* | | | | 0.20 | 0.34 | 0.07 | |
| *2002, 2015-2024, 2026-2027, 2108-2109* | | | | | (18.1,14) | (15.61,14) | (22.28,14) | |
| Red-Light Speed † | *All upgraded from RLC* | | | | 0.00005 | 0.46 | 0.008 | |
| *2001, 2003-2007, 2010/11,2012,2014,2025,2029,*  *2100-2104, 2106,2107* | | | | | (49.65,17) | (16.98,17) | (34.3,17) | |
|  |  |  | |
| Fixed Speed † | |  | | | 0.07 | <0.0001 | <0.0001 | |
|  | |  | | | (17.39,10) | (61.32,10) | (66.26,10) | |
| **Regions** ‡ | | |  | | 0.38 | 0.59 | 0.27 |
|  | |  | | | (20.3,19) | (17.06,19) | (22.2,19) |
| *Red-Light †* | |  | | | 0.10 | 0.79 | 0.21 |
|  | |  | | | (7.72,4) | (1.69,4) | (5.82,4) |
| *Red-Light Speed †* | |  | | | 0.31 | 0.70 | 0.71 |
| *All from no-camera* | |  | | | (3.6,3) | (2.19,4) | (2.14,4) |
| *Red-Light Speed †* | |  | | | 0.38 | 0.34 | 0.55 |
| *All upgraded from RLC* | |  | | | (4.21,4) | (4.55,4) | (3.04,4) |
| *Fixed Speed †* | |  | | | 0.76 | 0.54 | 0.47 |
|  | |  | | | (2.62,5) | (4.08,5) | (4.6,5) |

† Within model of one camera type ‡Where camera type was considered in the reduced model

\*\* Excluding 2101,2103,2106 and 2026 ‡‡Excluding 5001

There was no statistical evidence to support differential regional effects within a camera type or over all fixed camera types.

In contrast, there was strong statistical evidence to show that crash effects were different for different fixed spot camera types and that crash effects were different across sites of a camera type. The evidence of heterogeneity of camera sites was only poor when considering minor injury crashes at RLS camera intersections and when considering RLS cameras at intersections which never held a camera previously.

## Road Safety Camera Trailers

Table 22 presents a summary of the estimated crash effects associated with CDOP trailer cameras by crash severity and operation type or region grouping. The table presents the estimated relative risk, 95% statistical confidence limit on the estimate and statistical significance probability for each crash severity and region. Statistically significant crash reductions were found to be associated with the trailer camera program. An overall 40% reduction in serious casualty crashes and a 34% reduction in minor injury crashes were estimated. Reductions in crash risk were estimated to be associated with all three operation types, however the estimates only reached significance for crashes of targeted operations (37% casualty crash reduction). Estimates were less robust when disaggregated by region and urbanisation with only camera operations in the rural districts showing statistical significance across severities. Reductions of 72% of serious casualty and 74% of minor injury crashes were associated with trailer operations in the Southern Rural district. Reductions of 75% of serious casualty and 72% of minor injury crashes were associated with trailer operations in the Central Rural district. Reductions of 21% of serious casualty and 32% of minor injury crashes were associated with trailer operations in the South Eastern Rural district.

The following operations were excluded from all analyses so that regression algorithms could converge: 187903, 187906, 187910, 286903, 286902, 286904, 287903, 296902, 385906, 386901, 386903, 386904, 386906-386908, 486903, 486905, 486906, 487914-487915, 487917, 586901-586904. For just the minor crash analysis 385916, 486904, 487903 and 487916 were additionally excluded and for just the serious casualty crash analysis the following operations were also excluded from analysis: 185904, 286901, 287901, 287904, 287907, 287912, 386909, 387902, 387905, 387916, 486908, 487911, 586904 and 587904.

Annual crashes in the trailer operational periods, identified within the defined halo of influence, were tabled by severity, urbanisation and police region for 2020 to 2021. The average annual count (rounded to the nearest integer) over the period is given in Table 24 as a measure of the crash population covered by this camera type. Overall crash reduction estimates by severity were applied to the annual counts to produce the absolute crash savings per year given in Table 25. These were then costed by the WTP approach with results given in Table 26.

Results of homogeneity tests indicated that there was strong statistical evidence that the crash effects associated with the trailer camera operations differed between police regions by urbanisation (**Error! Reference source not found.**). By urbanisation, heterogeneity was only evidenced in rural regions. Homogeneity tests for the operation types school and roadworks in regional areas alone did not reach significance. Because of the lack of statistically significant reductions in urban regions, combined with the lack of proof of heterogeneity, average urban state-wide crash reductions associated with the different severities were used in the estimation of savings by region for the urban regions. For all other regions, relative risk estimates specific to each region-urbanisation category were used in the estimation of savings.

Table 22 Estimated crash risks associated with the road safety camera trailers (*relative risk estimate, 95% C.I., statistical significance*)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** | **All Casualty**† |
| All | 0.60 | 0.66 | 0.64 |
|  | (0.46,0.80.0) | (0.53,0.82) | (0.54,0.76) |
|  | 0.0003 | 0.0001 | <.0001 |
| Targeted | 0.60 | 0.65 | 0.63 |
|  | (0.45,0.81) | (0.51,0.81) | (0.52,0.75) |
|  | 0.001 | 0.0002 | <.0001 |
| Roadworks | 0.64 | 0.80 | 0.75 |
|  | (0.26,1.57) | (0.42,1.54) | (0.44,1.27) |
|  | 0.33 | 0.51 | 0.28 |
| School | 0.51 | 0.66 | 0.65 |
|  | (0.09,3.07) | (0.17,2.63) | (0.22,1.89) |
|  | 0.47 | 0.56 | 0.43 |
| All Urban | 0.97 | 0.95 | 0.97 |
|  | (0.56,1.70) | (0.64,1.40) | (0.70,1.33) |
|  | 0.93 | 0.79 | 0.83 |
| Brisbane | 1.06 | 0.86 | 0.92 |
|  | (0.51,2.21) | (0.55,1.37) | (0.62,1.36) |
|  | 0.88 | 0.54 | 0.67 |
| South Eastern | 1.02 | 1.57 | 1.31 |
| Urban | (0.34,3.11) | (0.6,4.09) | (0.63,2.71) |
|  | 0.97 | 0.36 | 0.46 |
| Southern Urban | 0.71 | 0.84 | 0.81 |
|  | (0.2,2.53) | (0.26,2.71) | (0.34,1.93) |
|  | 0.60 | 0.77 | 0.64 |
| All Rural | 0.52 | 0.58 | 0.55 |
|  | (0.38,0.71) | (0.45,0.74) | (0.45,0.67) |
|  | <.0001 | <.0001 | <.0001 |
| Central Rural | 0.25 | 0.28 | 0.27 |
|  | (0.10,0.65) | (0.13,0.62) | (0.15,0.5) |
|  | 0.004 | 0.002 | <.0001 |
| South Eastern | 0.69 | 0.68 | 0.68 |
| Rural | (0.47,1.00) | (0.52,0.89) | (0.55,0.85) |
|  | 0.05 | 0.006 | 0.0006 |
| Southern Rural | 0.28 | 0.26 | 0.26 |
|  | (0.13,0.58) | (0.11,0.62) | (0.15,0.46) |
|  | 0.001 | 0.002 | <.0001 |

† Estimated from an all casualty crash model

The casualty crash reductions of 36% (Table 22) associated with trailer operations translated to the average annual prevention of 38 casualty crashes, 17 of which were serious, saving society about $15M per year using WTP crash cost valuations.

Table 23 Significance probabilities from tests of homogeneity by injury severity for fixed camera analyses: (*Χ2, d.f.*)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | | **Serious Casualty** | **Minor injury** | **Casualty** | |
| **Operation Type** |  | | 0.98 | 0.83 | 0.83 | |
|  |  | | (0.04,2) | (0.37,2) | (0.36,2) | |
| **Sites** |  | | 0.02 | 0.003 | 0.00003 | |
|  |  | | (54.45,35) | (73.87,44) | (98.35,48) | |
| **Regions** |  | | 0.047 | 0.02 | 0.0002 | |
|  |  | | (11.21,5) | (13.39,5) | (24.65,5) | |
| Urban areas\* |  | | 0.86 | 0.54 | 0.64 | |
|  |  | | (0.29,2) | (1.22,2) | (0.88,2) | |
| Rural areas\* |  | | 0.03 | 0.02 | 0.0004 | |
|  |  | | (7.29,2) | (7.87,2) | (15.41,2) | |
| *Roadworks †* |  | | 0.53 | 0.47 | 0.60 |
|  |  | | (1.25,2) | (1.52,2) | (1.04,2) |
| *School Zone †* | |  | 0.15 | 0.17 | 0.07 |
|  |  | | (3.74,2) | (3.56,2) | (5.37,2) |
| *Targeted †* |  | | 0.004 | 0.02 | 0.00003 |
|  |  | | (17.56,5) | (13.19,5) | (28.47,5) |

† Regional heterogeneity examined within model of one camera type

\* Regional heterogeneity examined within a model of only either urban regions or rural regions.

Table 24 Average annual post-activation road safety camera trailer treatment crash counts by severity and police region

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** | **All Casualty** |
| All\* | 27 | 45 | 72 |
| Brisbane | 3 | 7 | 9 |
| Central Rural | 1 | 1 | 2 |
| S. Eastern Urban | 1 | 3 | 3 |
| S. Eastern Rural | 20 | 33 | 53 |
| Southern Urban | 1 | 1 | 2 |
| Southern Rural | 3 | 1 | 3 |

\*sum of regions, rounding applies

Table 25 Average annual absolute crash savings associated with road safety camera trailer, by severity and police region

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** | **All Casualty†** |
| All\* | 17 | 20 | 38 |
| Brisbane | 0 | 0 | 0 |
| Central Rural | 1 | 3 | 4 |
| S. Eastern Urban | 0 | 0 | 0 |
| S. Eastern Rural | 9 | 15 | 25 |
| Southern Urban | 0 | 0 | 0 |
| Southern Rural | 7 | 1 | 8 |

† Estimated from an all casualty crash model

\*sum of regions, rounding applies

Table 26 Average annual savings associated with red-light cameras, by severity and police region: Willingness to Pay approach

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** | **Casualty**† |
| All\* | $13,681,524 | $2,190,163 | $14,933,036 |
| Brisbane | $56,289 | $39,930 | $109,558 |
| Central Rural | $1,166,858 | $288,631 | $1,428,791 |
| S. Eastern Urban | $11,296 | $15,577 | $38,161 |
| S. Eastern Rural | $7,208,047 | $1,692,466 | $9,322,185 |
| Southern Urban | $20,892 | $6,081 | $25,641 |
| Southern Rural | $5,218,144 | $147,478 | $4,008,699 |

\*Sum of regions, rounding errors apply

† All Casualty is modelled separately and is not the sum of serious and minor.

## Mobile Speed Cameras

The evaluation design for the mobile speed camera program detailed Section 3.3.2 of Newstead et al (2020) was utilised to estimate the crash benefits of the mobile camera program in Queensland. Data were prepared as time series for analysis with interrogation of the data revealing a quarterly time period for data aggregation as being the most appropriate to support the analysis. Using quarterly time periods, crash counts in each quarter were sufficiently large enough to ensure model stability but quarter to quarter variation on operations was large enough to ensure reasonable analysis power.

Figure 4 shows an example of the resulting data series for one of the Queensland police regions, Southern Region. Colour coding indicates the comparable treatment and control pairs within urban and rural areas with the dotted line of each pair being the control area data series and the solid line the treatment series. As evident, each region has two treatment and control pairs resulting in ten treatment and control pairs (strata) for analysis across the five police regions.

Quarterly mobile speed camera program delivery measures were prepared for inclusion in the model. Consistent with the previous evaluation of CDOP effects to 2017, three measures of speed camera program delivery were used in the model: quarterly hours of overt car-based mobile speed camera operations, quarterly hours of car-based covert mobile speed camera operations, quarterly hours of portable or LTI mobile speed camera use all of which was considered overt. Figure 2 shows the quarterly mobile speed camera delivery measures across the whole of Queensland. For use in the analysis model, data series were derived for each stratum, defined by police region and urban and rural sector classification. Mobile speed camera operations delivery for each stratum determined though matching the site data for each camera with the sector in which the site was placed, and then aggregating the data across sectors based on their stratum membership. Trends in program delivery measures for each stratum are not shown here but the general trends in each stratum are broadly similar to the overall trends seen for Queensland as a whole in Figure 2 albeit with different patterns of quarterly variation.

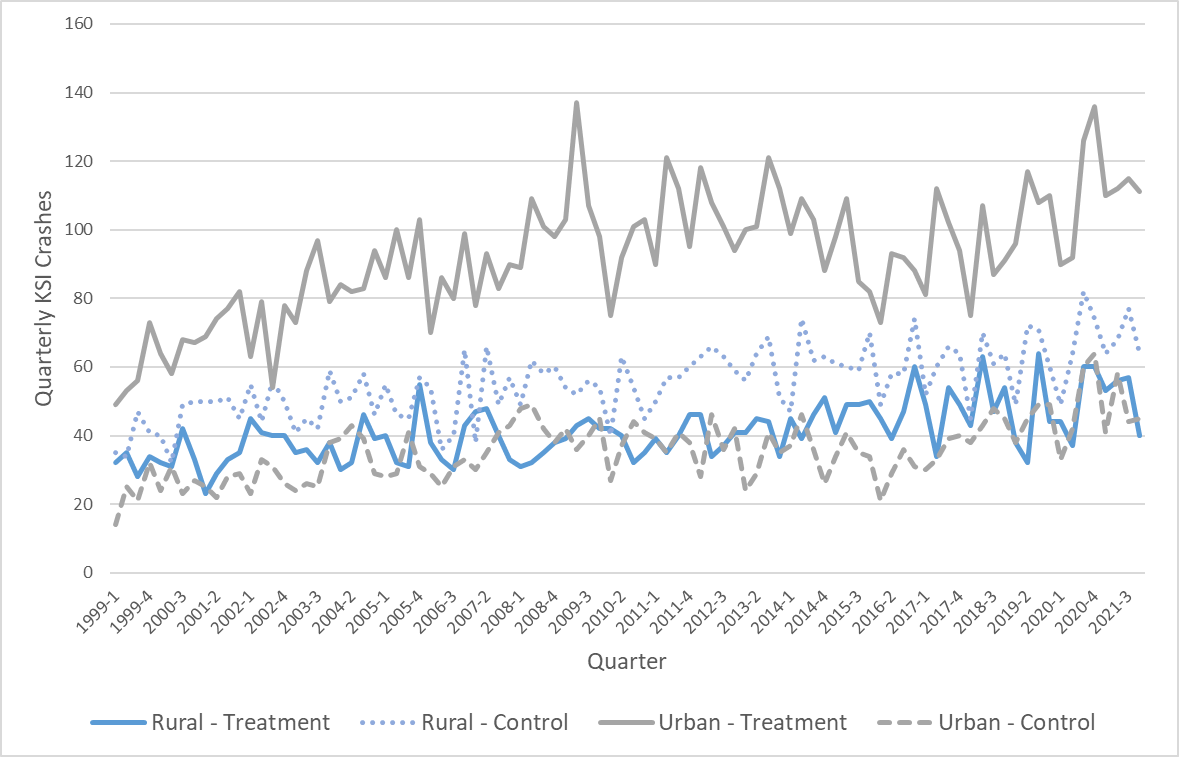


Figure 4 *Quarterly fatal and serious injury crash counts by treatment and control area in rural and urban sectors: Southern Region*

When assigning quarterly delivery data against the crash data within each stratum and treatment and control pair, only the treatment time series data had operations appearing against them consistent with the treatment sectors being defined as those where a mobile speed camera operation had taken place. All the quarterly control data series crash counts had zero mobile speed camera operations delivery assigned to them.

### Analysis model results

Results of application of the analysis model to the quarterly crash data series for each stratum and treatment control pair are summarised in the following tables. Two levels of crash severity were analysed: fatal and serious injury crashes combined, and all casualty crashes. Non-injury crashes have not been reported in Queensland since 2010 so could not be modelled. In addition, a third set of models were estimated for the probability that a casualty crash was serious or fatal (i.e. the estimated by proportion of all casualty crashes that are serious or fatal). The model structure for this additional analysis was the same as described in Equation 3 (in section 3.3.2. of Newstead et al (2020)) but with the log transform substituted by a logit transform, and the outcome being modelled being the proportion of casualty crashes in each stratum, treatment control pair and quarter that were serious casualty or fatal crashes. The purpose of the third model set was to formally test whether there were differential associations between the mobile speed camera delivery measures and combined fatal/serious or minor crash outcomes. Where there was no difference, the all casualty crash result, which has narrower statistical confidence limits, could be used to represent the impact of the program across all crash severity levels. Where there was a detected difference, specific estimates could be used for each crash severity level.

For each crash severity considered, two separate models were estimated. The first estimated the average association between the mobile speed camera program outputs and crash outcomes across all ten strata. The second estimated average effects within urban and rural areas across all five police regions. Models were also fitted that estimated average effects across urban and rural areas within each police region and overall effects across urban and rural areas within each police region. Both these analyses lacked sufficient power for the results to achieve statistical significance so the results are not reported here.

Table 27 presents the results of applying the evaluation framework model for mobile speed cameras to all casualty crashes. Information in Table 27 includes the label of the measure of mobile speed camera operation delivery included in the model, the parameter associated with that measure in the model of Newstead et al (2020) Equation 3, and the following measures associated with the parameter estimate: the standard error, the upper and lower 95% confidence, the significance probability and the chi-squared value and degrees of freedom (a measure of improvement in model fit) from which the significance values were estimated. The larger the absolute parameter estimate in Table 27, the stronger the association between the hours of mobile camera enforcement and quarterly road trauma counts. Negative parameter estimates indicate a decrease in quarterly road trauma counts associated with an increase in quarterly mobile speed camera hours. The top section of Table 27 gives the model output estimating average association between each of the three mobile speed camera delivery measures across all ten analysis strata. The bottom section of Table 27 gives the model results estimating average effects across urban and rural strata separately. Since the average estimate for portable / LTI cameras across urban and rural areas was not statistically significant (row 3 of Table 27) separate estimates by urban and rural areas for portable / LTI cameras were not estimated.

Table 27 Crash effects evaluation model parameter estimates for the mobile speed camera program considering all casualty crashes

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Whole State** | Estimate | SE | LCL | UCL | Chi-Sq. | df | Sig Prob |
| Deployment time (quarterly hours) of Overt Car Mobile Speed Cameras in given Region | -1.531E-05 | 4.679E-06 | -2.448E-05 | -6.135E-06 | 1.07E+01 | 1 | 0.001 |
| Deployment time (quarterly hours) of Covert Car Mobile Speed Cameras in given Region | -5.107E-05 | 1.598E-05 | -8.239E-05 | -1.976E-05 | 1.02E+01 | 1 | 0.001 |
| Deployment time (quarterly hours) of Portable / LTI Speed Cameras in Given Region | -2.072E-05 | 9.719E-06 | -3.977E-05 | -1.668E-06 | 4.54E+00 | 1 | 0.033 |
| **Urban and Rural** |  |  |  |  |  |  |  |
| Deployment time (quarterly hours) of Overt Car Mobile Speed Cameras in given Region - Urban | -1.27E-05 | 4.82E-06 | -2.21E-05 | -3.26E-06 | 6.948 | 1 | 0.008 |
| Deployment time (quarterly hours) of Overt Car Mobile Speed Cameras in given Region - Rural | -6.10E-05 | 2.15E-05 | -1.03E-04 | -1.89E-05 | 8.067 | 1 | 0.005 |
| Deployment time (quarterly hours) of Covert Car Mobile Speed Cameras in given Region - Urban | -5.58E-05 | 1.69E-05 | -8.89E-05 | -2.27E-05 | 10.935 | 1 | <.001 |
| Deployment time (quarterly hours) of Covert Car Mobile Speed Cameras in given Region - Rural | -8.07E-05 | 5.73E-05 | -1.93E-04 | 3.16E-05 | 1.985 | 1 | 0.159 |
| Deployment time (quarterly hours) of Portable / LTI Speed Cameras in Given Region - Urban | -2.27E-05 | 9.91E-06 | -4.22E-05 | -3.31E-06 | 5.261 | 1 | 0.022 |
| Deployment time (quarterly hours) of Portable / LTI Speed Cameras in Given Region – Rural\* |  |  |  |  |  |  |  |

\* estimate did not converge

Table 27 shows statistically significant association between quarterly hours of all three operation types (covert, overt and portable/LTI) and quarterly counts of all casualty crashes on average across all ten strata. The association with covert hours was much stronger as shown by the much larger negative parameter estimate. When considering average effects across urban and rural strata separately (bottom of Table 27), covert operations were once again more strongly associated with all casualty crashes compared to overt operations, although the estimates were not statistically significant for operations in rural regions. There was also a significant difference in the level of association for overt car mobile speed camera enforcement delivery mode between urban and rural areas, with rural areas showing the stronger association with all casualty crashes.

Table 28 Crash effects evaluation model parameter estimates for the mobile speed camera program considering all serious casualty (crashes resulting in death or seriously injury) crashes

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Whole State** | Estimate | SE | LCL | UCL | Chi-Sq. | df | Sig Prob |
| Deployment time (quarterly hours) of Overt Car Mobile Speed Cameras in given Region | -1.67E-05 | 7.62E-06 | -3.16E-05 | -1.74E-06 | 4.79E+00 | 1 | 0.029 |
| Deployment time (quarterly hours) of Covert Car Mobile Speed Cameras in given Region | -1.90E-05 | 2.44E-05 | -6.68E-05 | 2.89E-05 | 6.04E-01 | 1 | 0.437 |
| Deployment time (quarterly hours) of Portable / LTI Speed Cameras in Given Region | -4.70E-05 | 1.50E-05 | -7.63E-05 | -1.76E-05 | 9.82E+00 | 1 | 0.002 |
|  |  |  |  |  |  |  |  |
| **Urban and Rural** |  |  |  |  |  |  |  |
| Deployment time (quarterly hours) of Overt Car Mobile Speed Cameras in given Region - Urban | -1.15E-05 | 7.96E-06 | -2.71E-05 | 4.13E-06 | 2.076 | 1 | 0.15 |
| Deployment time (quarterly hours) of Overt Car Mobile Speed Cameras in given Region - Rural | -7.88E-05 | 2.92E-05 | -1.36E-04 | -2.16E-05 | 7.288 | 1 | 0.007 |
| Deployment time (quarterly hours) of Covert Car Mobile Speed Cameras in given Region - Urban | -1.89E-05 | 2.64E-05 | -7.05E-05 | 3.28E-05 | 0.512 | 1 | 0.474 |
| Deployment time (quarterly hours) of Covert Car Mobile Speed Cameras in given Region - Rural | -8.32E-05 | 7.45E-05 | -2.29E-04 | 6.28E-05 | 1.247 | 1 | 0.264 |
| Deployment time (quarterly hours) of Portable / LTI Speed Cameras in Given Region - Urban | -5.22E-05 | 1.54E-05 | -8.24E-05 | -2.20E-05 | 11.502 | 1 | <.001 |
| Deployment time (quarterly hours) of Portable / LTI Speed Cameras in Given Region – Rural\* |  |  |  |  |  |  |  |

\* estimate did not converge

Table 28 gives the analogous model output to Table 27 but for the models considering serious casualty crashes (fatal and serious injury crashes combined). Table 28 shows statistically significant association between both quarterly portable / LTI speed camera and car covert speed camera hours and serious casualty crash counts on average across the state (top of Table 28). Results by urban and rural areas in the bottom of Table 28 shows that the overall portable / LTI camera association across the state results entirely from a strong association in urban areas; the association in rural areas was not statistically significant. Similarly, the car overt camera association results from a strong rural association; the association in urban areas was not statistically significant. No statistically significant associations between the covert car-based mobile speed camera operations and serious casualty crashes were estimated, most likely due to a lack of statistical analysis power.

Table 29 presents the results of the logistic regression analysis which tests whether the analogous parameters from Table 27 and Table 28 are statistically different. Considering the difference measure first, Table 29 shows no statistically significant difference in the association between all casualty crashes and fatal and serious injury crashes for car-based mobile speed camera operations. For portable / LTI mobile speed camera operations, Table 29 shows the association with fatal and serious crashes is much stronger than with all casualty crashes. This association is statistically significant overall and in urban areas.

Table 29 Crash effects evaluation model parameter estimates for the mobile speed camera program considering the odds of a serious casualty crash per casualty crash

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Whole State** | Estimate | SE | LCL | UCL | Chi-Sq. | df | Sig Prob |
| Deployment time (quarterly hours) of Overt Car Mobile Speed Cameras in given Region | -2.97E-06 | 1.00E-05 | -2.27E-05 | 1.67E-05 | 0.087 | 1 | 0.768 |
| Deployment time (quarterly hours) of Covert Car Mobile Speed Cameras in given Region | 3.01E-05 | 3.30E-05 | -3.46E-05 | 9.48E-05 | 0.831 | 1 | 0.362 |
| Deployment time (quarterly hours) of Portable / LTI Speed Cameras in Given Region | -4.86E-05 | 2.00E-05 | -8.78E-05 | -9.37E-06 | 5.896 | 1 | 0.015 |
|  |  |  |  |  |  |  |  |
| **Urban and Rural** |  |  |  |  |  |  |  |
| Deployment time (quarterly hours) of Overt Car Mobile Speed Cameras in given Region - Urban | -5.43E-07 | 1.03E-05 | -2.08E-05 | 1.97E-05 | 0.003 | 1 | 0.958 |
| Deployment time (quarterly hours) of Overt Car Mobile Speed Cameras in given Region - Rural | -4.54E-05 | 4.39E-05 | 0.00E+00 | 4.06E-05 | 1.071 | 1 | 0.301 |
| Deployment time (quarterly hours) of Covert Car Mobile Speed Cameras in given Region - Urban | 5.30E-05 | 3.49E-05 | -1.55E-05 | 0.00E+00 | 2.301 | 1 | 0.129 |
| Deployment time (quarterly hours) of Covert Car Mobile Speed Cameras in given Region - Rural | -8.57E-05 | 1.00E-04 | -2.82E-04 | 1.10E-04 | 0.528 | 1 | 0.467 |
| Deployment time (quarterly hours) of Portable / LTI Speed Cameras in Given Region - Urban | -5.28E-05 | 2.04E-05 | -9.28E-05 | -1.28E-05 | 6.682 | 1 | 0.010 |
| Deployment time (quarterly hours) of Portable / LTI Speed Cameras in Given Region – Rural\* |  |  |  |  |  |  |  |

\* estimate did not converge

Table 29 shows that there were no statistically significant differences between effects on all casualty crashes and serious casualty crashes for car-based enforcement meaning the significant all casualty crash estimates for car operations can be applied equally across all crash severity levels. In contrast, Table 29 shows differing crash effects for LTI operation between serious casualty and minor injury crashes meaning results specific to the crash severity being considered should be used for the LTI camera estimates in urban areas where a significant association with crash outcomes was estimated.

In summary, analysis results showed significant association between the quarterly hours of mobile speed camera operations and quarterly crash counts in areas with mobile speed camera enforcement compared to control areas without mobile speed camera enforcement. The association between covert and overt mobile speed camera operations was consistent across crash severity levels with stronger associations measured for covert versus overt operations, stronger effects in rural versus urban areas and different relative effects between covert and overt operations between urban and rural areas. Reflecting these differences, the model estimates within the bold black boxes in Table 27 have been used to estimate the crash effects of overt and covert car-based mobile camera operations in urban areas for all crash severities. Only portable camera operations in metro areas were significantly associated with crashes. Furthermore, the association was different between serious casualty crashes and minor crashes. Hence, crash severity specific estimates for portable cameras from Tables 27 and 28 were used subsequently in the analysis.

In updating the evaluation of the mobile speed camera element of CDOP, the initial intent was to use the relationships between operational hours and crash outcomes established in Newstead et al (2020). Due to the significant differences in mobile speed camera hours and distributions of operation types over 2018 to 2021, it was decided to re-estimate the relationships to make sure they still held in the environment of extrapolated hours. Reassuringly, the updated estimates of association between enforcement hours and crash outcomes in this study were highly consistent with those established in the previous study of Newstead et al (2022) both in terms of the statistically significant associations as well as the relative magnitude of the parameter estimates. Estimates derived from this study are expected to be more accurate, being based on an addition 2 years of crash data related to mobile speed camera hours of operation.

Efficacy of utilising the above modelling results to estimate the casualty crash effects of the Queensland mobile speed camera program related to operation of each camera type depends on how well the models fitted predict crash outcome. Lack of model fit would suggest that other factors not represented by the mobile speed camera operations measures are impacting program effectiveness. If this was the case, basing the estimated road safety benefit of the program only on these measures would give a biased measure of effectiveness.

Figure 5 shows the observed and fitted quarterly crash counts in the treatment group across all ten strata from the all casualty crash analysis model with separate urban and rural effects for each mobile speed camera program output measure. Fits for the urban and rural effects model were chosen since parameter estimates from this model have been used to represent program crash effects related to covert and overt car-based operations. As evident from the figure, the model provides highly accurate estimation of the observed data meaning the speed camera operations measures in the data combined with the control area data are providing a highly accurate representation of the data. Concordance between the observed and modelled data, as represented by the square of the correlation between the two series, was very high at 99.8%. From this it can be concluded that the casualty crash model is highly efficacious for estimating program crash effects.

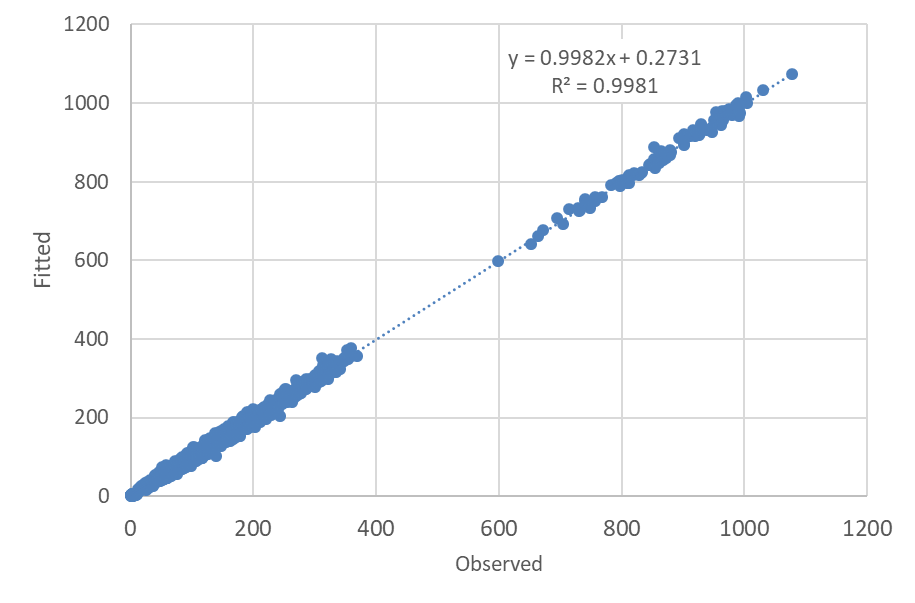


Figure 5 *Observed versus fitted quarterly treatment area casualty crash counts for model with urban and rural program effect estimates*

Figure 6 provides the analogous model fit data for the fatal and serious injury crash count model. Estimates from this model represent the effect of the potable / LTI cameras on serious injury and fatal crashes in urban areas so fit of this model is also critical. Figure 6 shows that the fit of this model to the observed data is also extremely good with a concordance measure of 99.4% showing this model is also efficacious for representing mobile speed camera effects on fatal and serious injury crashes.

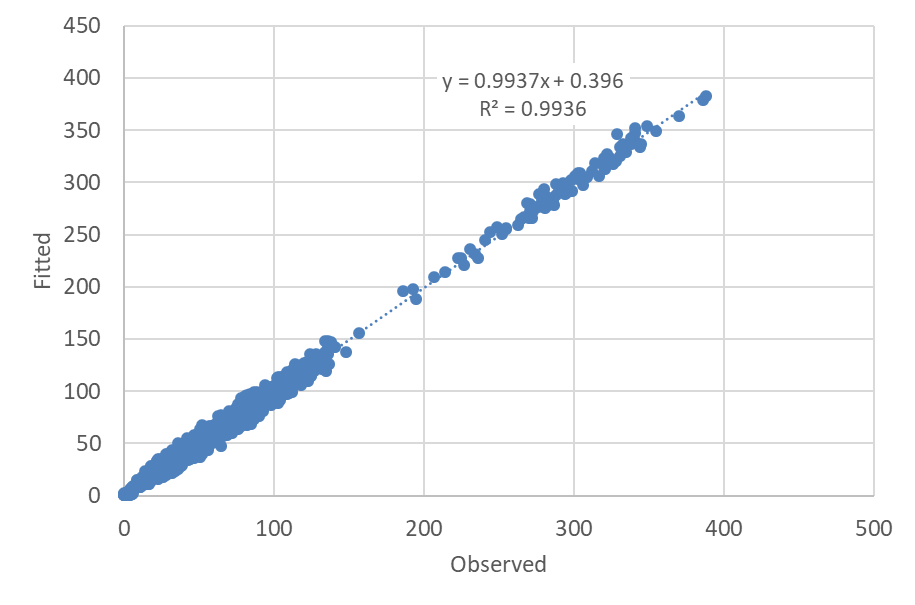


Figure 6 *Observed versus fitted quarterly treatment area fatal and serious injury crash counts for model with urban and rural program effect estimates*

Deriving a sense of the relative impact on each of the three mobile speed camera operations types on crash outcomes using only the key parameter estimates from Table 27 and Table 28 is difficult. To assist with interpretation, the parameters have been converted to percentage reduction in crashes associated with operation of each camera type in each area over a range of total monthly output hours across Queensland as a whole. The relationships for overt car-based, covert car-based and portable / LTI operations are shown in Figures 7, 8 and 9 respectively.

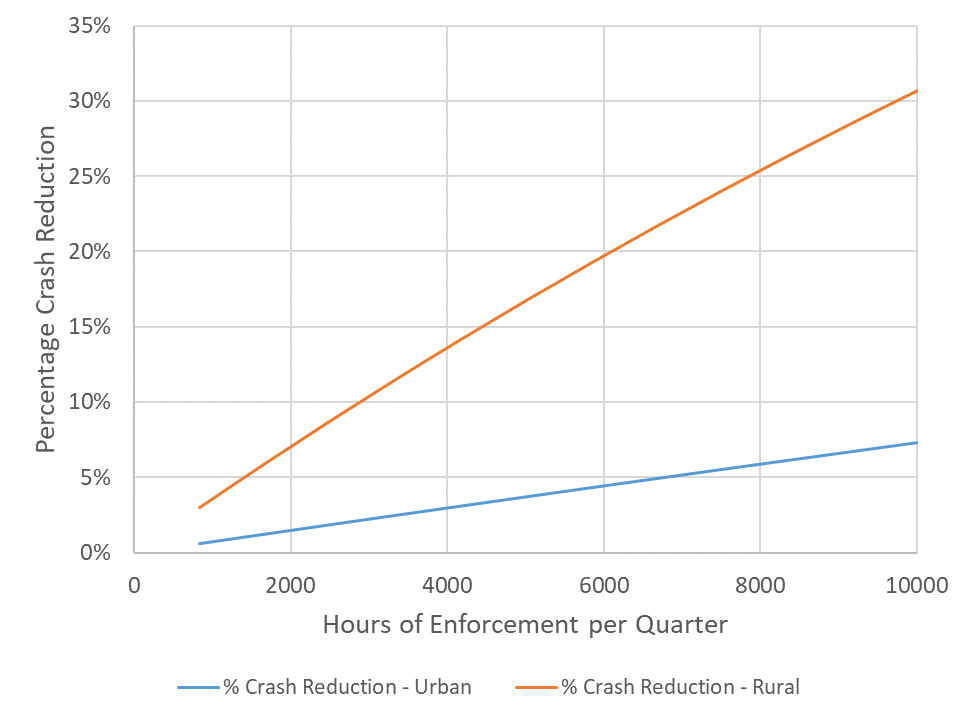


Figure 7 *Relationship between monthly hours of overt car-based mobile speed camera hours across Queensland and estimated percentage casualty crash reductions in urban and rural areas*

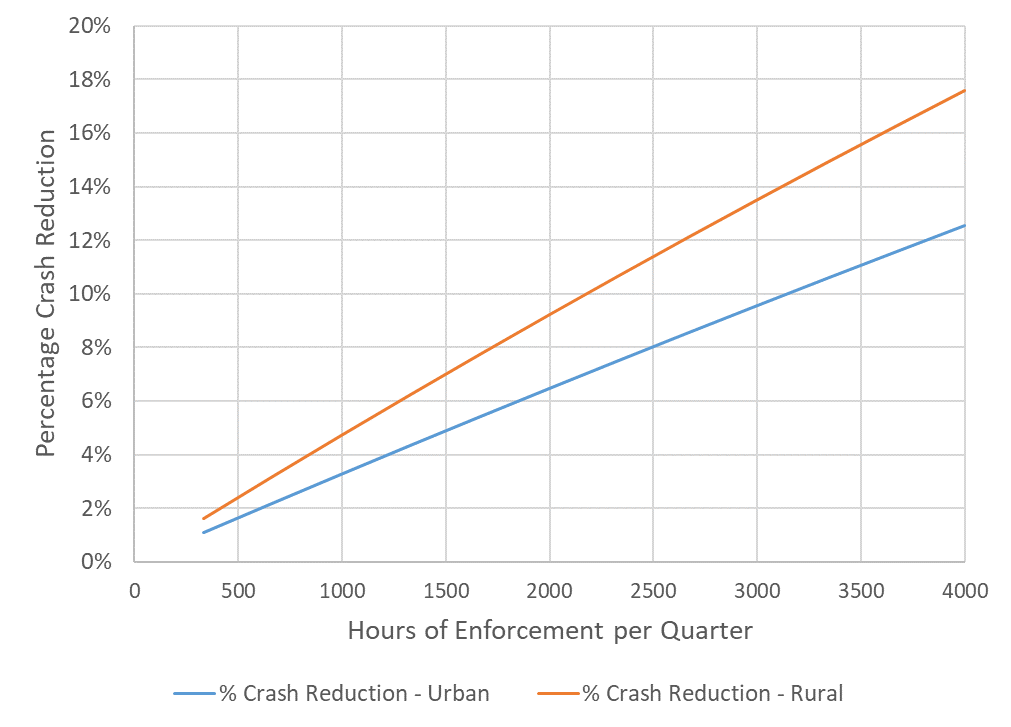


Figure 8 *Relationship between monthly hours of covert car-based mobile speed camera hours across Queensland and estimated percentage casualty crash reductions in urban and rural areas*

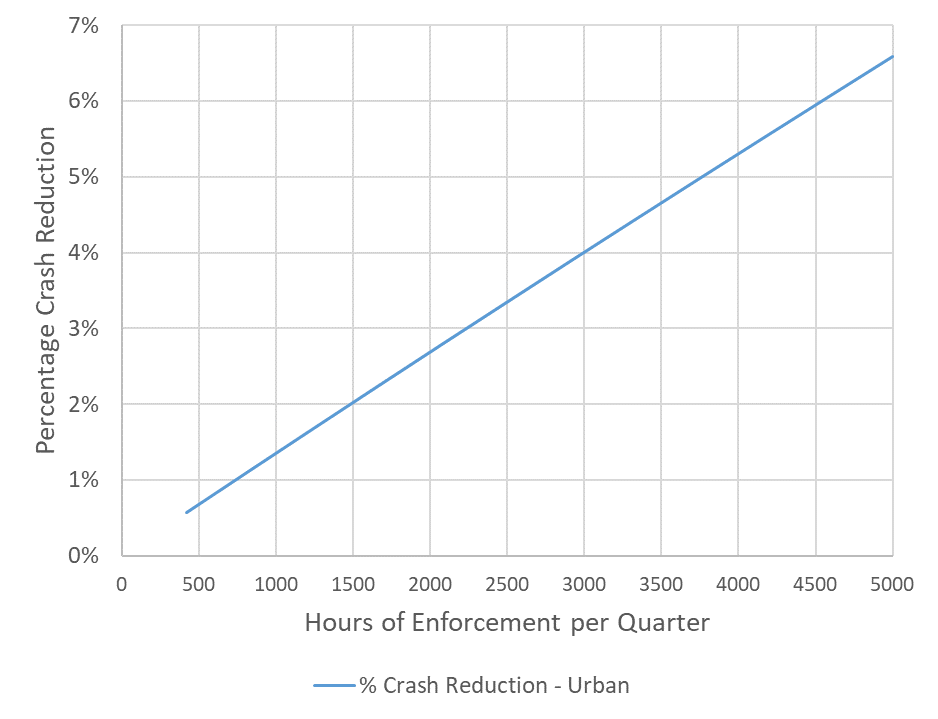


Figure 9 *Relationship between monthly hours of portable / LTI mobile speed camera hours across Queensland and estimated percentage casualty crash reductions in urban areas*

Comparison of the results in Figures 7-9 show some notable differences in the relative crash effects of each camera type per hour of enforcement as well as differences between urban and rural operation. Both Figures 7 and 8 show higher percentage crash reductions per hour of enforcement in rural areas compared to urban areas for car-based operations. Notably, the difference between urban and rural areas is much narrower for covert car-based enforcement. Covert enforcement also produces much greater percentage crash reductions per hour of enforcement than overt enforcement. For example, in urban areas a 5% reduction is achieved at 7,000 hours of enforcement per month for overt enforcement compared to 1500 hours for covert enforcement. In rural areas, the comparable figures are 1,400 hours for overt enforcement and 1,000 hours for covert enforcement. Portable / LTI enforcement in urban areas is slightly more efficient than car-based overt operations with a 5% reduction being achieved at around 3,750 hours of enforcement per month.

### Crash and crash cost savings associated with the mobile speed camera program over time

Results of modelling presented above provide estimates of the relationship between levels of operation of each camera type in urban and rural areas and the corresponding percentage reduction in crashes relative to no enforcement. In order to utilise the estimates to derive the impact of the Queensland mobile speed camera program on crashes in a particular time period, the level of camera operations at the particular time point were applied to the observed crash frequency in that time period to estimate the expected crash frequency had the mobile speed camera program not been in operation. From this, it was possible to derive the absolute crash savings in the time period associated with operation of each camera type and in aggregate. Equation 2 gives the formula for estimating the crash savings, Δ*Csgt*, in time period *t* for region *s* and treatment and control group *g*. In the equation, *Csgt* is the observed crash count in the stratum and time period, Measures *Osgt, Vsgt* and *Lsgt* are the hours of each speed camera operation type enforcement in the stratum in time period. Parameters A, B and C represent the association between the hours of mobile speed camera enforcement of each type respectively and crash counts in each time period estimated from the model. Crash savings in the control group will be zero since the speed camera operations hours for all camera types in the control group are zero.

… (Equation 2)

Crash savings across aggregate time periods or strata can be calculated by summing the individual stratum and time period savings estimated from Equation 2. Marginal effects of each camera type in each time period and stratum can be estimated by applying Equation 3 as an example.

… (Equation 3)

As demonstrated by the form of Equation 2 which related to the original form of the analysis model, total savings across all camera types are calculated by multiplying the effects of individual cameras, as distinct from simply adding the effects. These methods have been applied to estimate the annual crash savings associated with the Queensland mobile speed camera program by police region and by specific camera type and urban or rural environment.

Table 30 shows the estimated annual fatal crash savings associated with the Queensland mobile speed camera program by police region. Figure 10 gives the corresponding information in Table 30 graphically. Table 31 and corresponding Figure 11 give estimated fatal crash savings associated with the program by year, camera type and urban or rural location. Analogous information for serious injury crash savings and minor injury crash savings are given in Table 32 to Table 35 and Figures 12-15.

Table 30 Estimated fatal crash savings associated with the Queensland mobile speed camera program by year and police region

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Brisbane | Central | Northern | South Eastern | Southern | Total |
| 1999 | 0.78 | 1.54 | 0.33 | 0.23 | 0.70 | 3.58 |
| 2000 | 0.76 | 1.96 | 0.47 | 0.30 | 0.97 | 4.46 |
| 2001 | 1.49 | 3.09 | 0.58 | 0.39 | 1.85 | 7.39 |
| 2002 | 1.28 | 4.61 | 0.81 | 0.50 | 1.19 | 8.40 |
| 2003 | 2.32 | 7.44 | 0.90 | 0.63 | 1.00 | 12.30 |
| 2004 | 2.41 | 5.97 | 0.71 | 0.56 | 1.91 | 11.57 |
| 2005 | 3.51 | 8.10 | 2.29 | 0.65 | 2.02 | 16.57 |
| 2006 | 2.49 | 6.39 | 1.99 | 0.74 | 1.90 | 13.52 |
| 2007 | 2.60 | 8.56 | 1.10 | 0.90 | 2.28 | 15.44 |
| 2008 | 1.28 | 6.31 | 1.78 | 0.69 | 1.81 | 11.87 |
| 2009 | 1.66 | 7.24 | 2.10 | 0.45 | 1.24 | 12.68 |
| 2010 | 2.08 | 6.10 | 1.21 | 0.32 | 1.27 | 10.98 |
| 2011 | 2.98 | 3.97 | 0.52 | 0.90 | 1.58 | 9.94 |
| 2012 | 2.68 | 5.13 | 1.63 | 0.92 | 1.78 | 12.15 |
| 2013 | 2.95 | 5.66 | 1.08 | 1.02 | 1.70 | 12.42 |
| 2014 | 3.53 | 3.17 | 1.16 | 0.74 | 1.45 | 10.04 |
| 2015 | 4.24 | 3.72 | 1.81 | 1.11 | 2.02 | 12.90 |
| 2016 | 6.70 | 3.62 | 1.56 | 1.83 | 2.04 | 15.75 |
| 2017 | 8.20 | 4.26 | 1.89 | 2.00 | 1.90 | 18.25 |
| 2018 | 8.00 | 4.00 | 1.57 | 0.87 | 2.20 | 16.64 |
| 2019 | 5.48 | 2.92 | 2.60 | 0.53 | 2.17 | 13.70 |
| 2020 | 2.88 | 5.56 | 1.90 | 0.91 | 2.29 | 13.55 |
| 2021 | 4.68 | 5.77 | 1.44 | 1.16 | 2.74 | 15.79 |

Yearly trends in absolute crash savings associated with the Queensland mobile speed camera program can be seen in Figures 10 to 15. After significant growth in effectiveness of the program from 1999 to 2003, reflecting significant growth in total hours of enforcement across the state, effectiveness plateaued over the next ten years. Increasing effects on fatal crashes were observed from 2014 to 2017 corresponding to an increase in enforcement hours and in particular an increase in the number of hours of covert enforcement. In 2020, possibly due to the COVID-19 pandemic, lower enforcement hours were achieved, particularly for covert and portable-LTI operations (Figure 2). A return to greater than pre-pandemic operation hours was achieved in 2021. Overall, there were 10% more hours of car operations in 2020/2021 in both rural and urban sectors than in 2018/2019. However, a change in the distribution in operational hours between camera types amounted to a 39% drop in portable/LTI and a 51% drop in covert hours from 2018/2019 to 2020/2021.

Despite decreases in covert and portable enforcement hours in 2020, and a continued slight decline in coverage of the fatal crash population by the program (Figure 16), fatal crash savings were estimated to be maintained at near 2019 levels (about 3% lower). Effectiveness was maintained through the increase in overt operations, particularly in rural areas where the program is associated with greater crash reductions per hour enforced. However, the proportion of covert operations in urban areas decreased dramatically, as did the use of portable cameras. Consequently, the trauma savings realised in 2020 were lower than could have been achieved if greater proportions of covert can and portable camera enforcement were used. Estimated fatality savings associated with the program in 2021 were greater than in 2020 largely reflecting the increase in total hours of enforcement compared to 2020 (Figure 2). Although the total hours of enforcement in 2021 were greater than that achieved in 2018, the estimated fatal crash savings were lower. This reflected the lower proportion of covert car-based operations, particularly in urban areas, and portable operations used in 2021 compared to 2018. Again, total crash savings in 2021 could have been greater if a higher proportion of covert operations were deployed.

In 2020 and 2021 there was a greater proportion of fatality savings in the Central police region and in rural regions more generally than in previous years (Figure 10). This reflects the general shift of the enforcement focus to regional areas. As noted this has had a positive impact in being associated with greater crash reductions based on the stronger association between rural operations and crash savings. The greatest absolute fatal crash savings were estimated for the Brisbane and Central areas reflecting the high concentration of the total crash population in these areas.

Table 31 Estimated fatal crash savings associated with the Queensland mobile speed camera program by year camera type and level of urbanisation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Rural Covert Car | Rural Overt Car | Rural Portable/ LTI | Urban Covert Car | Urban Overt Car | Urban Portable/ LTI |
| 1999 | 0.00 | 2.40 |  |  | 1.18 |  |
| 2000 | 0.00 | 3.18 |  |  | 1.28 |  |
| 2001 | 0.00 | 5.23 |  |  | 2.16 |  |
| 2002 | 0.00 | 6.28 |  |  | 2.12 |  |
| 2003 | 0.00 | 8.69 |  |  | 3.61 |  |
| 2004 | 0.00 | 7.98 |  |  | 3.59 |  |
| 2005 | 0.00 | 11.83 |  |  | 4.74 |  |
| 2006 | 0.00 | 9.21 |  |  | 4.31 |  |
| 2007 | 0.00 | 11.46 |  |  | 3.98 |  |
| 2008 | 0.00 | 9.08 |  |  | 2.79 |  |
| 2009 | 0.00 | 9.67 |  |  | 3.02 |  |
| 2010 | 0.00 | 7.69 |  | 1.17 | 2.13 |  |
| 2011 | 0.00 | 5.61 | 0.00 | 2.41 | 1.83 | 0.10 |
| 2012 | 0.00 | 6.60 | 0.00 | 2.58 | 2.20 | 0.77 |
| 2013 | 0.00 | 7.15 | 0.00 | 1.70 | 1.57 | 2.00 |
| 2014 | 0.00 | 4.35 | 0.00 | 1.91 | 1.52 | 2.27 |
| 2015 | 0.00 | 4.62 | 0.00 | 1.74 | 2.00 | 4.53 |
| 2016 | 0.00 | 4.34 | 0.00 | 1.71 | 2.37 | 7.34 |
| 2017 | 0.00 | 4.18 | 0.00 | 4.51 | 2.50 | 7.06 |
| 2018 | 0.00 | 5.25 | 0.00 | 4.12 | 2.07 | 5.21 |
| 2019 | 0.00 | 3.94 | 0.00 | 3.19 | 2.40 | 4.17 |
| 2020 | 0.00 | 6.93 | 0.00 | 1.05 | 2.78 | 2.79 |
| 2021 | 0.00 | 7.01 | 0.00 | 0.95 | 4.09 | 3.74 |

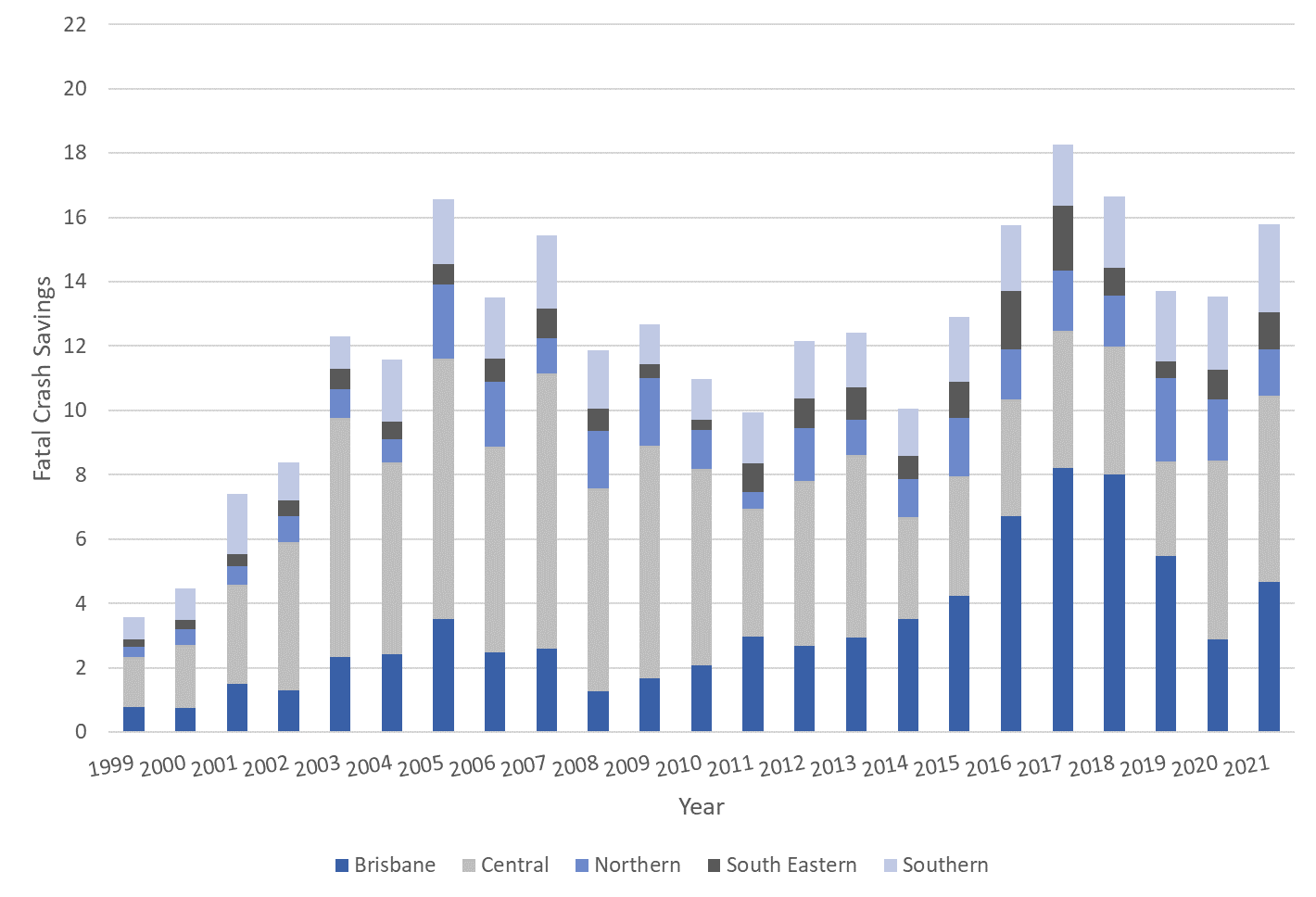


Figure 10 Estimated fatal crash savings associated with the Queensland mobile speed camera program by year and police region

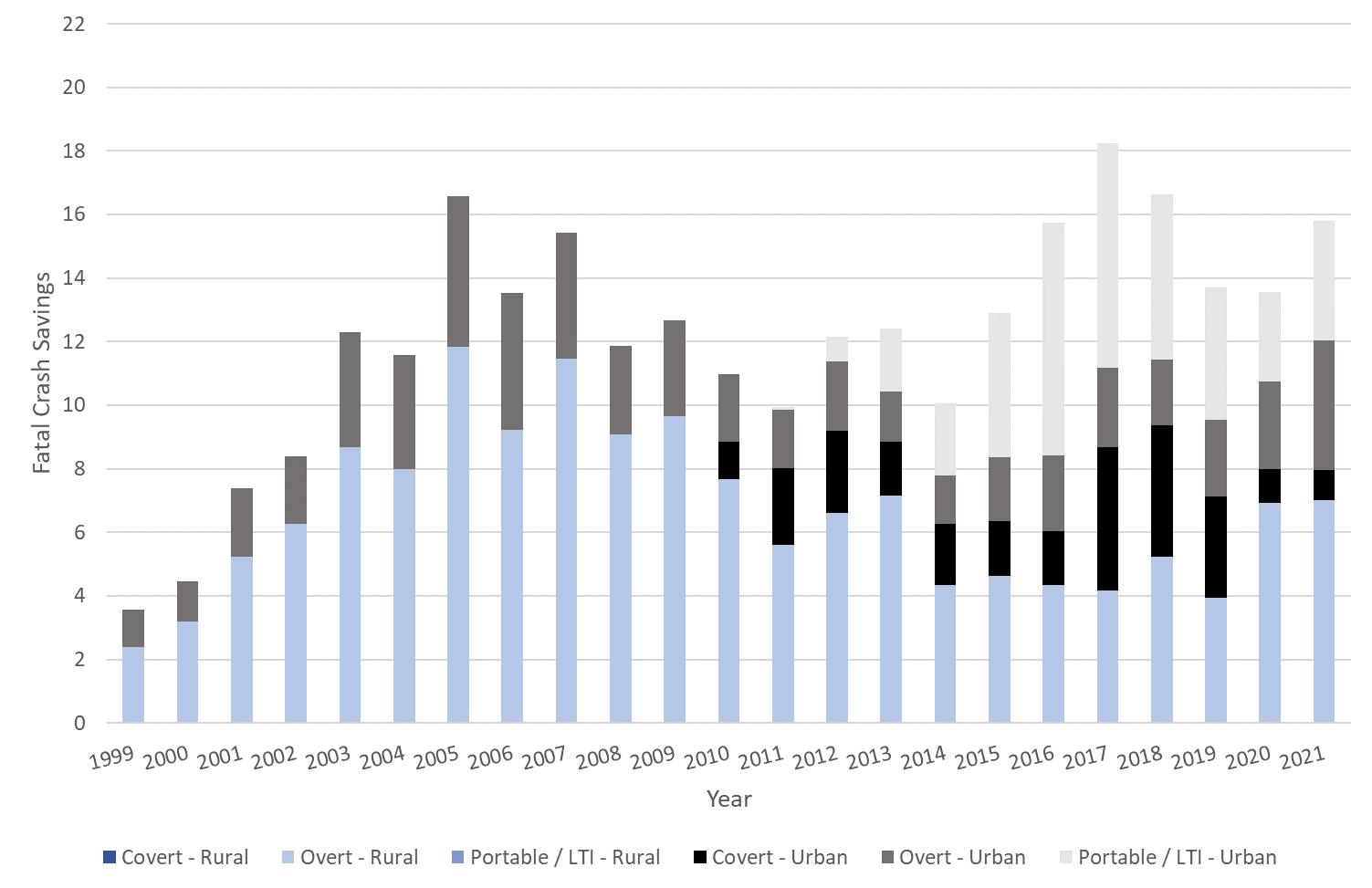


Figure 11 Estimated fatal crash savings associated with the Queensland mobile speed camera program by year camera type and level of urbanisation

Estimated serious injury savings associated with the Queensland mobile camera program by region and camera type are presented in Tables 32 and 33 and corresponding Figures 12 and 13. Observations about relative program effects between years and regions are similar to those made for fatal crashes. They again largely reflecting the change in distribution of mobile camera enforcement between available camera types with a shift away from covert enforcement in 2020 and 2021 and an increasing proportion of rural operations. The impact of reduced enforcement generally in 2020 was estimated to have a particularly negative impact on serious crash savings estimated to be associated with the program in that year.

Table 32 Estimated serious injury crash savings associated with the Queensland mobile speed camera program by year and police region

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Brisbane | Central | Northern | South Eastern | Southern | Total |
| 1999 | 14.44 | 11.05 | 4.04 | 3.19 | 5.75 | 38.47 |
| 2000 | 20.14 | 15.38 | 6.00 | 4.76 | 10.29 | 56.56 |
| 2001 | 36.03 | 25.69 | 7.20 | 8.15 | 11.93 | 88.99 |
| 2002 | 41.35 | 30.29 | 9.20 | 8.35 | 11.72 | 100.90 |
| 2003 | 62.47 | 44.00 | 14.55 | 13.81 | 17.85 | 152.67 |
| 2004 | 67.36 | 52.39 | 15.57 | 13.18 | 16.02 | 164.52 |
| 2005 | 115.03 | 58.40 | 24.06 | 24.17 | 26.88 | 248.54 |
| 2006 | 73.35 | 51.87 | 21.66 | 11.70 | 20.72 | 179.29 |
| 2007 | 72.24 | 52.86 | 18.73 | 12.33 | 22.02 | 178.19 |
| 2008 | 70.23 | 58.47 | 19.34 | 13.55 | 20.18 | 181.77 |
| 2009 | 74.39 | 57.04 | 17.42 | 12.80 | 23.66 | 185.31 |
| 2010 | 116.28 | 53.93 | 23.68 | 16.27 | 24.67 | 234.83 |
| 2011 | 148.50 | 58.18 | 32.62 | 24.00 | 28.65 | 291.94 |
| 2012 | 167.68 | 62.87 | 29.50 | 23.13 | 30.23 | 313.41 |
| 2013 | 278.18 | 76.38 | 43.09 | 36.73 | 43.36 | 477.75 |
| 2014 | 271.84 | 69.60 | 45.54 | 42.52 | 46.77 | 476.27 |
| 2015 | 259.97 | 70.08 | 46.10 | 51.08 | 57.77 | 485.00 |
| 2016 | 250.43 | 66.75 | 53.81 | 56.98 | 51.83 | 479.80 |
| 2017 | 302.56 | 74.74 | 54.58 | 59.91 | 56.28 | 548.06 |
| 2018 | 423.41 | 92.40 | 62.64 | 60.63 | 69.98 | 709.07 |
| 2019 | 365.33 | 98.32 | 58.96 | 44.46 | 73.76 | 640.83 |
| 2020 | 185.15 | 88.80 | 39.77 | 35.29 | 65.13 | 414.14 |
| 2021 | 254.30 | 127.30 | 64.47 | 46.04 | 83.50 | 575.61 |

Table 33 Estimated serious injury crash savings associated with the Queensland mobile speed camera program by year camera type and level of urbanisation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Rural Covert Car | Rural Overt Car | Rural Portable/ LTI | Urban Covert Car | Urban Overt Car | Urban Portable/ LTI |
| 1999 | 0.00 | 17.20 |  | 0.00 | 21.27 |  |
| 2000 | 0.00 | 25.74 |  | 0.00 | 30.82 |  |
| 2001 | 0.00 | 35.51 |  | 0.00 | 53.49 |  |
| 2002 | 0.00 | 39.58 |  | 0.00 | 61.33 |  |
| 2003 | 0.00 | 58.16 |  | 0.00 | 94.51 |  |
| 2004 | 0.00 | 64.88 |  | 0.00 | 99.64 |  |
| 2005 | 0.00 | 85.62 |  | 0.00 | 162.92 |  |
| 2006 | 0.00 | 71.10 |  | 0.00 | 108.19 |  |
| 2007 | 0.00 | 69.63 |  | 0.00 | 108.56 |  |
| 2008 | 0.00 | 70.95 |  | 0.00 | 110.82 |  |
| 2009 | 0.00 | 68.55 |  | 0.00 | 116.75 |  |
| 2010 | 0.00 | 65.32 |  | 55.89 | 113.62 |  |
| 2011 | 0.00 | 59.36 | 0.00 | 129.94 | 96.38 | 6.26 |
| 2012 | 0.00 | 60.41 | 0.00 | 114.15 | 100.89 | 37.96 |
| 2013 | 0.00 | 68.13 | 0.00 | 130.52 | 119.33 | 159.77 |
| 2014 | 0.00 | 58.97 | 0.00 | 136.82 | 109.31 | 171.17 |
| 2015 | 0.00 | 52.58 | 0.00 | 94.21 | 104.10 | 234.10 |
| 2016 | 0.00 | 37.23 | 0.00 | 70.06 | 87.95 | 284.57 |
| 2017 | 0.00 | 50.37 | 0.00 | 157.86 | 93.26 | 246.56 |
| 2018 | 0.00 | 67.18 | 0.00 | 228.66 | 116.41 | 296.82 |
| 2019 | 0.00 | 69.31 | 0.00 | 177.01 | 146.08 | 248.43 |
| 2020 | 0.00 | 82.57 | 0.00 | 48.97 | 149.73 | 132.86 |
| 2021 | 0.00 | 111.24 | 0.00 | 55.44 | 215.61 | 193.32 |

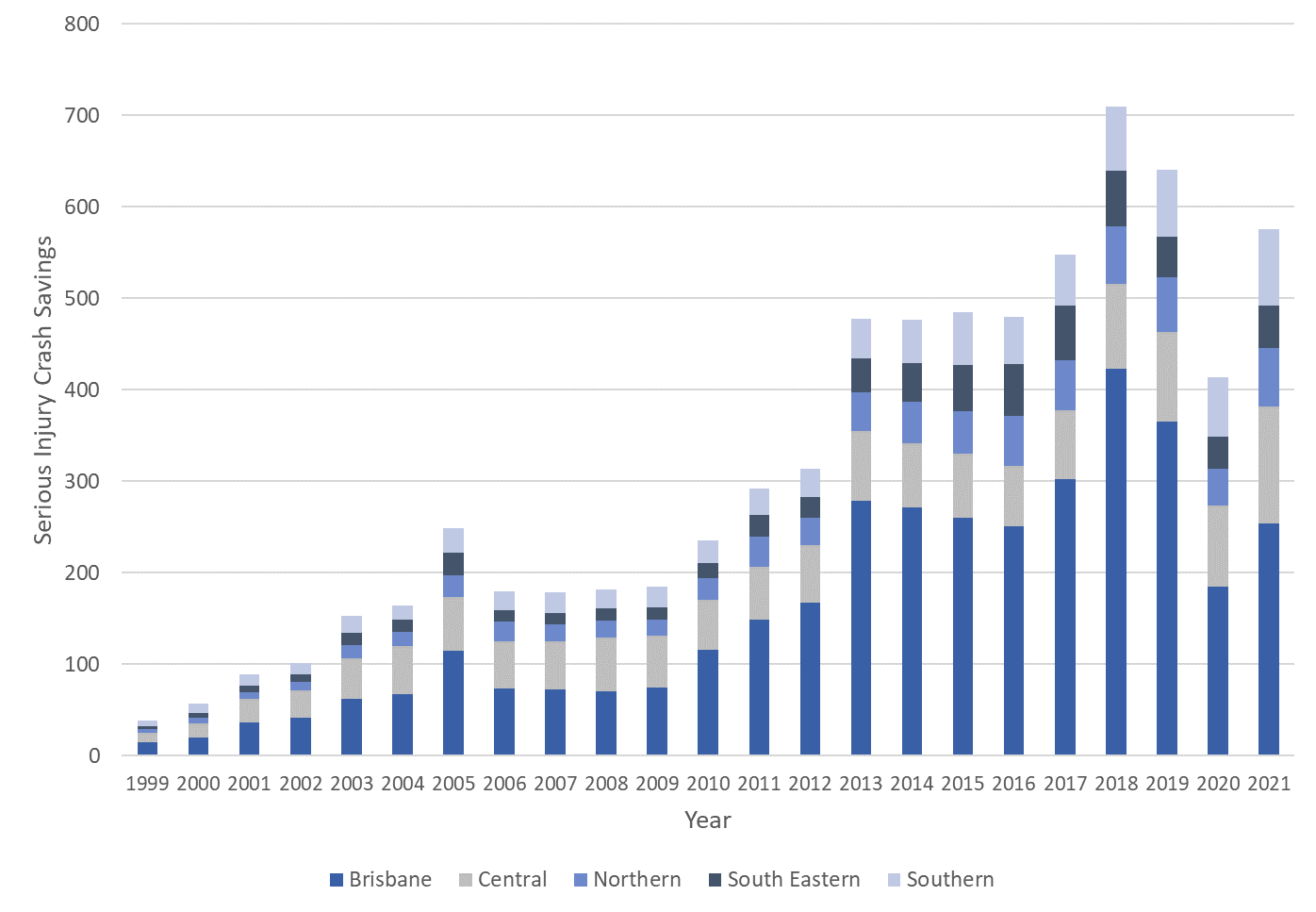


Figure 12 Estimated serious crash savings associated with the Queensland mobile speed camera program by year and police region

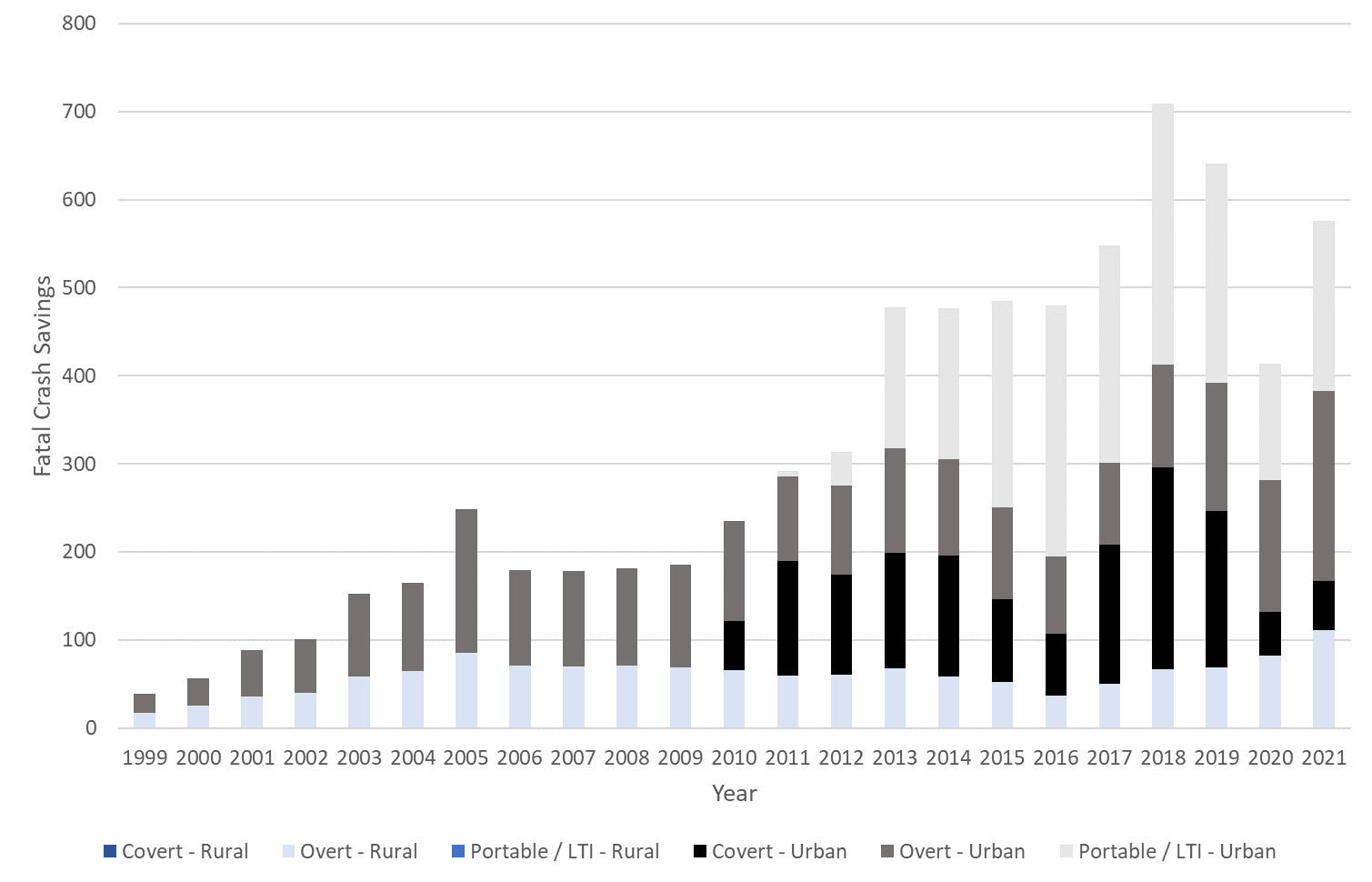


Figure 13 Estimated serious crash savings associated with the Queensland mobile speed camera program by year camera type and level of urbanisation

Estimated savings in minor injury crashes by camera operation type and region are given in Tables 34 and 35 and corresponding Figures 14 and 15. Observations from these figures are very similar to those made for serious injury crashes.

Table 34 Estimated minor injury crash savings associated with the Queensland mobile speed camera program by year and police region

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Brisbane | Central | Northern | South Eastern | Southern | Total |
| 1999 | 39.26 | 13.52 | 5.86 | 5.55 | 8.46 | 72.65 |
| 2000 | 52.78 | 16.55 | 7.14 | 9.73 | 11.88 | 98.07 |
| 2001 | 107.85 | 28.86 | 10.53 | 17.08 | 20.09 | 184.41 |
| 2002 | 107.90 | 40.92 | 12.12 | 16.98 | 17.94 | 195.86 |
| 2003 | 160.05 | 51.62 | 16.95 | 25.46 | 23.99 | 278.06 |
| 2004 | 152.62 | 49.61 | 18.58 | 20.07 | 23.43 | 264.32 |
| 2005 | 237.15 | 60.71 | 23.63 | 47.57 | 30.35 | 399.41 |
| 2006 | 162.88 | 61.08 | 25.54 | 22.50 | 29.66 | 301.66 |
| 2007 | 156.14 | 71.91 | 27.75 | 23.81 | 32.41 | 312.02 |
| 2008 | 137.43 | 56.70 | 23.22 | 23.08 | 31.68 | 272.11 |
| 2009 | 128.73 | 55.96 | 20.74 | 21.49 | 27.91 | 254.82 |
| 2010 | 201.38 | 60.40 | 25.33 | 27.83 | 29.82 | 344.76 |
| 2011 | 262.44 | 56.84 | 35.55 | 37.54 | 31.27 | 423.63 |
| 2012 | 263.26 | 54.75 | 30.14 | 34.93 | 32.36 | 415.44 |
| 2013 | 317.34 | 59.63 | 36.67 | 41.85 | 37.90 | 493.40 |
| 2014 | 345.35 | 59.25 | 37.66 | 54.02 | 39.47 | 535.74 |
| 2015 | 316.32 | 55.20 | 36.36 | 59.46 | 54.03 | 521.36 |
| 2016 | 289.12 | 40.03 | 43.71 | 63.90 | 49.91 | 486.67 |
| 2017 | 428.40 | 49.97 | 36.39 | 66.00 | 52.09 | 632.85 |
| 2018 | 605.47 | 58.69 | 40.61 | 62.41 | 56.50 | 823.67 |
| 2019 | 513.37 | 59.35 | 39.42 | 57.48 | 60.33 | 729.96 |
| 2020 | 237.55 | 47.26 | 25.52 | 37.08 | 42.80 | 390.22 |
| 2021 | 306.52 | 70.68 | 39.35 | 45.49 | 58.94 | 520.98 |

Table 35 Estimated minor crash savings associated with the Queensland mobile speed camera program by year camera type and level of urbanisation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Rural Covert Car | Rural Overt Car | Rural Portable/ LTI | Urban Covert Car | Urban Overt Car | Urban Portable/ LTI |
| 1999 | 0.00 | 17.41 |  | 0.00 | 55.25 |  |
| 2000 | 0.00 | 22.22 |  | 0.00 | 75.85 |  |
| 2001 | 0.00 | 36.54 |  | 0.00 | 147.87 |  |
| 2002 | 0.00 | 44.68 |  | 0.00 | 151.18 |  |
| 2003 | 0.00 | 53.83 |  | 0.00 | 224.23 |  |
| 2004 | 0.00 | 53.80 |  | 0.00 | 210.52 |  |
| 2005 | 0.00 | 72.36 |  | 0.00 | 327.05 |  |
| 2006 | 0.00 | 70.05 |  | 0.00 | 231.61 |  |
| 2007 | 0.00 | 79.72 |  | 0.00 | 232.29 |  |
| 2008 | 0.00 | 58.65 |  | 0.00 | 213.46 |  |
| 2009 | 0.00 | 56.24 |  | 0.00 | 198.59 |  |
| 2010 | 0.00 | 57.36 |  | 98.45 | 188.94 |  |
| 2011 | 0.00 | 44.04 | 0.00 | 223.31 | 151.13 | 5.15 |
| 2012 | 0.00 | 39.32 | 0.00 | 190.52 | 154.06 | 31.53 |
| 2013 | 0.00 | 42.53 | 0.00 | 187.92 | 153.18 | 109.77 |
| 2014 | 0.00 | 36.62 | 0.00 | 212.76 | 153.57 | 132.79 |
| 2015 | 0.00 | 30.46 | 0.00 | 148.64 | 155.88 | 186.38 |
| 2016 | 0.00 | 20.28 | 0.00 | 108.37 | 136.92 | 221.10 |
| 2017 | 0.00 | 24.96 | 0.00 | 260.27 | 144.81 | 202.80 |
| 2018 | 0.00 | 34.25 | 0.00 | 377.44 | 165.31 | 246.66 |
| 2019 | 0.00 | 32.30 | 0.00 | 276.17 | 218.55 | 202.94 |
| 2020 | 0.00 | 36.55 | 0.00 | 55.55 | 212.26 | 85.85 |
| 2021 | 0.00 | 50.85 | 0.00 | 49.03 | 296.87 | 124.23 |

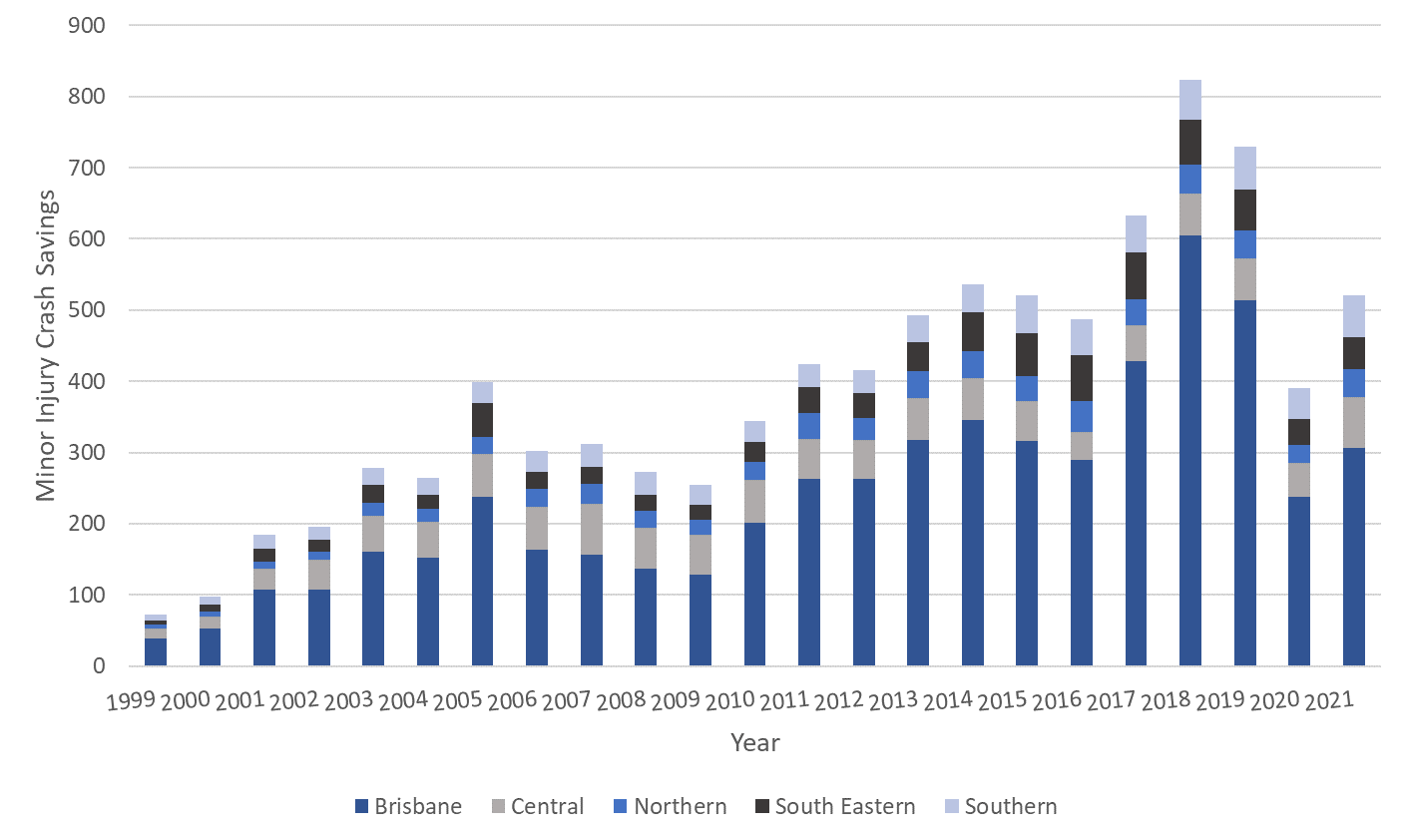


Figure 14 Estimated minor crash savings associated with the Queensland mobile speed camera program by year and police region

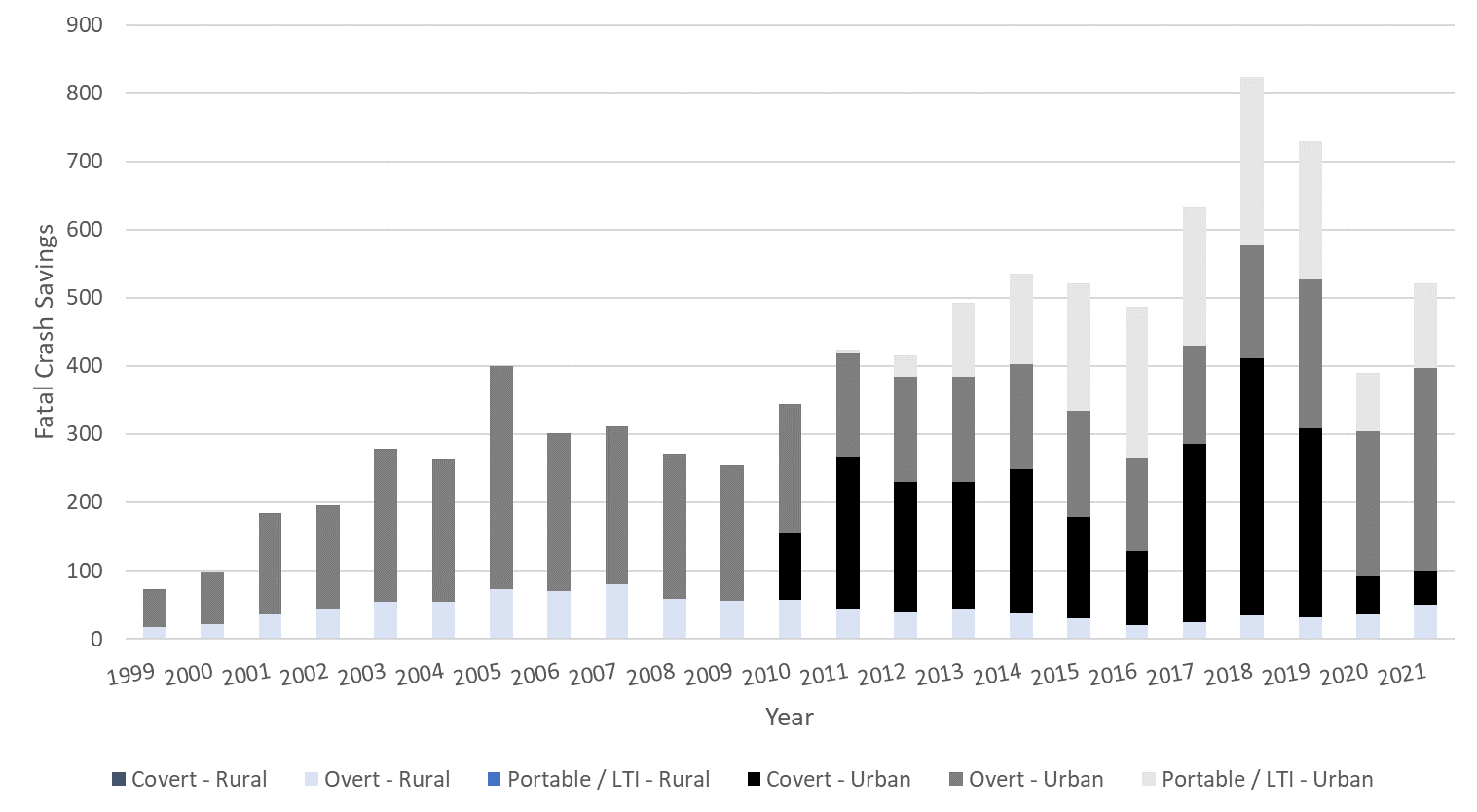


Figure 15 Estimated minor crash savings associated with the Queensland mobile speed camera program by year camera type and level of urbanisation

Coverage of the Queensland crash population by the mobile speed camera program is shown in Figure 16. Coverage of the serious and minor injury crash population in Queensland by the mobile speed camera program has been consistent over time at around 65% and 73% respectively. In contrast, coverage of the fatal crash population has decreased slightly over time from around 60% to around 50%.

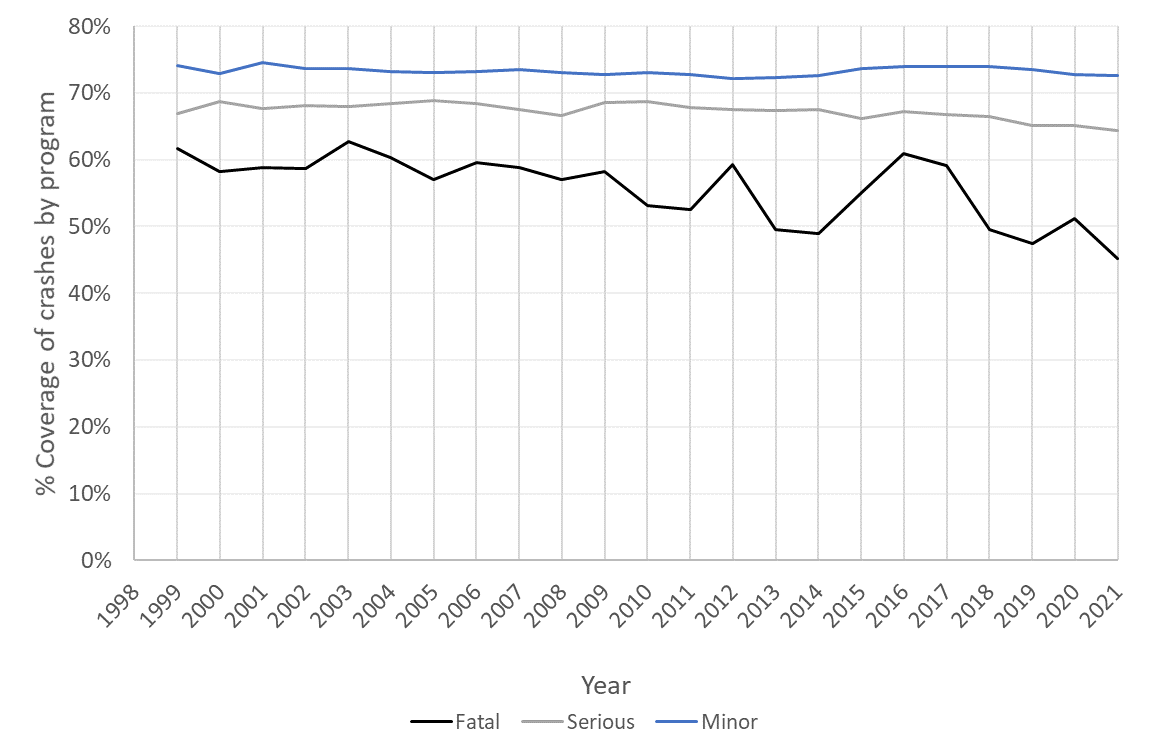


Figure 16 Percentage of total Queensland crash population coverage by the Queensland mobile camera program by crash severity

In order to estimate savings to the community through crash reductions associated with the Queensland mobile speed camera program, the estimated crash savings given in Table 30 to Table 35 were converted to community cost savings using the per crash cost values given in Table 3. Costs evaluated as willingness-to-pay are presented in Table 36.

In 2020, it was estimated that the mobile camera program was associated with cost savings to the community of $474M based on the WTP methodology. Corresponding savings for 2021 were $649M based on the WTP. These cost savings were down 39% and 16% on the peak year for community cost savings in 2018. Also evident from the tables is that the vast majority of the savings, around 91% were estimated to be derived from estimated savings in fatal and serious injury crashes. This proportion has increased since the last analysis and is reflective of a more severe crash population.

Forty percent of the estimated cost savings and more than half of the estimated crash savings were derived from the Brisbane region due to the high proportion of serious injury crash savings derived from this region. This result highlights the importance of not just targeting fatalities with a mobile speed camera program but particularly targeting the high proportion of serious injuries occurring in dense urban areas.

More than a quarter of the estimated cost savings and 22% of fatal and serious injury crash savings were derived from the Central region which may be due to fatal crash savings being predominant in this area. These results highlight the importance of operations addressing the geographical distribution of fatalities.

Table 36 Estimated community cost savings associated with the Queensland mobile speed camera program by year crash severity and region: Willingness to pay cost basis

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Brisbane | Central | Northern | South Eastern | Southern | Total |
| Fatal and Serious Injury Crashes | | | | | | |
| **1999** | $13,060,586 | $17,419,947 | $5,872,725 | $3,445,222 | $8,121,730 | $47,920,210 |
| **2000** | $17,933,386 | $23,871,831 | $8,709,452 | $4,894,834 | $14,387,895 | $69,797,397 |
| **2001** | $32,174,401 | $39,818,187 | $10,354,950 | $8,099,007 | $17,062,144 | $107,508,689 |
| **2002** | $36,607,925 | $47,930,451 | $13,312,298 | $8,370,105 | $15,778,606 | $121,999,385 |
| **2003** | $55,690,719 | $71,075,992 | $20,745,178 | $13,578,597 | $22,143,014 | $183,233,501 |
| **2004** | $60,075,320 | $80,715,428 | $21,303,807 | $12,862,484 | $21,101,241 | $196,058,279 |
| **2005** | $101,926,618 | $91,589,283 | $36,218,470 | $23,026,478 | $35,473,019 | $288,233,868 |
| **2006** | $65,185,841 | $80,019,430 | $31,162,225 | $11,886,727 | $27,260,968 | $215,515,191 |
| **2007** | $64,327,590 | $84,087,598 | $25,567,601 | $12,801,727 | $29,310,228 | $216,094,744 |
| **2008** | $61,418,857 | $88,709,366 | $27,413,558 | $13,681,043 | $25,271,745 | $216,494,568 |
| **2009** | $65,213,546 | $87,583,755 | $25,096,448 | $12,797,740 | $28,531,940 | $219,223,429 |
| **2010** | $101,558,697 | $80,195,493 | $31,962,085 | $15,671,832 | $29,121,382 | $258,509,489 |
| **2011** | $129,918,255 | $79,538,417 | $37,248,066 | $23,136,530 | $33,529,769 | $303,371,036 |
| **2012** | $146,048,354 | $86,627,557 | $35,019,642 | $22,346,816 | $35,158,700 | $325,201,068 |
| **2013** | $241,035,508 | $102,102,750 | $48,544,159 | $34,898,802 | $48,187,606 | $474,768,825 |
| **2014** | $236,066,673 | $88,337,605 | $49,671,236 | $39,710,812 | $51,459,896 | $465,246,221 |
| **2015** | $226,411,612 | $88,711,080 | $48,427,481 | $47,858,602 | $62,326,796 | $473,735,571 |
| **2016** | $220,387,313 | $80,414,276 | $53,621,041 | $53,610,836 | $55,444,420 | $463,477,885 |
| **2017** | $266,304,750 | $93,645,470 | $55,280,130 | $56,458,295 | $60,297,556 | $531,986,200 |
| **2018** | $369,694,549 | $112,828,282 | $64,677,922 | $56,264,443 | $77,205,485 | $680,670,680 |
| **2019** | $318,048,204 | $117,012,945 | $63,091,916 | $41,632,443 | $80,353,771 | $620,139,279 |
| **2020** | $161,446,558 | $114,344,552 | $46,301,935 | $34,372,715 | $74,033,666 | $430,499,426 |
| **2021** | $222,358,544 | $160,453,556 | $68,189,410 | $45,240,020 | $94,897,502 | $591,139,034 |
| Minor Injury Crashes | | | | | | |
| **1999** | $4,364,724 | $1,505,077 | $657,838 | $602,337 | $949,782 | $8,079,759 |
| **2000** | $5,868,127 | $1,842,345 | $800,016 | $1,055,083 | $1,331,967 | $10,897,537 |
| **2001** | $11,991,923 | $3,212,174 | $1,179,344 | $1,852,697 | $2,253,942 | $20,490,080 |
| **2002** | $11,997,390 | $4,560,932 | $1,357,998 | $1,841,393 | $2,015,396 | $21,773,109 |
| **2003** | $17,795,982 | $5,746,208 | $1,898,626 | $2,761,306 | $2,695,854 | $30,897,976 |
| **2004** | $16,970,294 | $5,523,635 | $2,080,481 | $2,177,414 | $2,632,498 | $29,384,321 |
| **2005** | $26,369,229 | $6,759,158 | $2,653,084 | $5,160,231 | $3,406,373 | $44,348,074 |
| **2006** | $18,111,361 | $6,800,356 | $2,862,220 | $2,440,675 | $3,330,115 | $33,544,726 |
| **2007** | $17,361,828 | $8,006,222 | $3,110,641 | $2,582,321 | $3,640,138 | $34,701,151 |
| **2008** | $15,280,794 | $6,304,877 | $2,598,747 | $2,503,285 | $3,560,356 | $30,248,060 |
| **2009** | $14,313,213 | $6,228,735 | $2,317,950 | $2,330,391 | $3,138,348 | $28,328,637 |
| **2010** | $22,391,251 | $6,710,310 | $2,835,483 | $3,018,665 | $3,352,766 | $38,308,475 |

Table 36 continued

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Brisbane | Central | Northern | South Eastern | Southern | Total |
| Minor Injury Crashes | | | | | | |
| **2011** | $29,179,858 | $6,293,674 | $3,960,753 | $4,071,638 | $3,516,361 | $47,022,285 |
| **2012** | $29,271,042 | $6,056,094 | $3,357,028 | $3,788,947 | $3,639,205 | $46,112,316 |
| **2013** | $35,284,587 | $6,596,103 | $4,085,148 | $4,539,159 | $4,263,909 | $54,768,906 |
| **2014** | $38,398,414 | $6,543,845 | $4,188,853 | $5,859,788 | $4,440,433 | $59,431,332 |
| **2015** | $35,170,627 | $6,093,569 | $4,040,867 | $6,449,745 | $6,082,861 | $57,837,669 |
| **2016** | $32,146,838 | $4,415,046 | $4,852,104 | $6,930,989 | $5,619,864 | $53,964,841 |
| **2017** | $47,631,940 | $5,511,994 | $4,041,754 | $7,159,595 | $5,865,790 | $70,211,073 |
| **2018** | $67,320,308 | $6,474,929 | $4,514,980 | $6,769,696 | $6,358,407 | $91,438,320 |
| **2019** | $57,080,940 | $6,541,741 | $4,382,966 | $6,234,868 | $6,790,905 | $81,031,421 |
| **2020** | $26,413,819 | $5,225,498 | $2,839,459 | $4,021,936 | $4,814,807 | $43,315,519 |
| **2021** | $34,082,624 | $7,811,182 | $4,378,098 | $4,933,791 | $6,630,129 | $57,835,824 |
| All Casualty Crashes | | | | | | |
| **1999** | $17,425,310 | $18,925,025 | $6,530,563 | $4,047,559 | $9,071,512 | $55,999,969 |
| **2000** | $23,801,512 | $25,714,176 | $9,509,468 | $5,949,916 | $15,719,862 | $80,694,934 |
| **2001** | $44,166,325 | $43,030,361 | $11,534,294 | $9,951,704 | $19,316,086 | $127,998,769 |
| **2002** | $48,605,315 | $52,491,382 | $14,670,296 | $10,211,498 | $17,794,002 | $143,772,494 |
| **2003** | $73,486,701 | $76,822,200 | $22,643,804 | $16,339,904 | $24,838,868 | $214,131,477 |
| **2004** | $77,045,613 | $86,239,063 | $23,384,287 | $15,039,899 | $23,733,739 | $225,442,600 |
| **2005** | $128,295,846 | $98,348,441 | $38,871,554 | $28,186,709 | $38,879,392 | $332,581,942 |
| **2006** | $83,297,202 | $86,819,785 | $34,024,445 | $14,327,402 | $30,591,083 | $249,059,917 |
| **2007** | $81,689,418 | $92,093,820 | $28,678,243 | $15,384,048 | $32,950,366 | $250,795,894 |
| **2008** | $76,699,651 | $95,014,243 | $30,012,305 | $16,184,328 | $28,832,101 | $246,742,628 |
| **2009** | $79,526,759 | $93,812,490 | $27,414,398 | $15,128,130 | $31,670,288 | $247,552,066 |
| **2010** | $123,949,949 | $86,905,802 | $34,797,568 | $18,690,496 | $32,474,148 | $296,817,964 |
| **2011** | $159,098,113 | $85,832,091 | $41,208,820 | $27,208,168 | $37,046,130 | $350,393,321 |
| **2012** | $175,319,396 | $92,683,651 | $38,376,670 | $26,135,763 | $38,797,905 | $371,313,384 |
| **2013** | $276,320,095 | $108,698,853 | $52,629,307 | $39,437,961 | $52,451,515 | $529,537,730 |
| **2014** | $274,465,087 | $94,881,450 | $53,860,089 | $45,570,599 | $55,900,328 | $524,677,553 |
| **2015** | $261,582,239 | $94,804,649 | $52,468,348 | $54,308,346 | $68,409,657 | $531,573,240 |
| **2016** | $252,534,152 | $84,829,322 | $58,473,145 | $60,541,824 | $61,064,283 | $517,442,726 |
| **2017** | $313,936,690 | $99,157,465 | $59,321,884 | $63,617,890 | $66,163,346 | $602,197,274 |
| **2018** | $437,014,856 | $119,303,211 | $69,192,901 | $63,034,139 | $83,563,892 | $772,109,000 |
| **2019** | $375,129,144 | $123,554,686 | $67,474,882 | $47,867,312 | $87,144,676 | $701,170,701 |
| **2020** | $187,860,377 | $119,570,050 | $49,141,393 | $38,394,652 | $78,848,472 | $473,814,945 |
| **2021** | $256,441,168 | $168,264,738 | $72,567,508 | $50,173,812 | $101,527,631 | $648,974,858 |

## State-wide Estimates of CDOP Effectiveness IN 2020-2021

A primary objective of this study was to estimate the overall effects of the CDOP in both the 2020 and 2021 calendar years. Each of the preceding sections have estimated the impacts of the various elements of the CDOP on crash frequency and cost, estimating total crash savings and their associated cost. Since the evaluation design has estimated discrete effects of each CDOP element, the overall impact of the program in 2020 and 2021 can be estimated by summing estimates from the individual elements to give the state-wide impact. The fixed crash components were derived from separate regression analysis for serious casualty, minor injury and casualty. The mobile components were derived from separate fatal, serious and minor regression outputs. Table 37 shows the resulting estimated crash savings across all CDOP elements by region and for the whole of Queensland. Savings are presented for serious casualty crashes (fatal and serious injury), minor injury crashes and total casualty crash savings.

Table 37 Overall crash savings associated with the CDOP in 2020 and 2021 by region, crash severity and in total.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** | **Casualty** |
| ***2020*** |  |  |  |
| **All** (Sum of Regions) | **457** | **444** | **897** |
| % Attributable to Mobile Speed Cameras | 94% | 88% | 91% |
| Brisbane | 197 | 250 | 446 |
| Central | 100 | 69 | 166 |
| Northern | 43 | 27 | 68 |
| South Eastern | 43 | 55 | 97 |
| Southern | 74 | 44 | 119 |
| ***2021*** |  |  |  |
| **All** (Sum of Regions) | **621** | **575** | **1191** |
| % Attributable to Mobile Speed Cameras | 95% | 91% | 93% |
| Brisbane | 268 | 319 | 586 |
| Central | 139 | 93 | 229 |
| Northern | 67 | 40 | 106 |
| South Eastern | 54 | 63 | 117 |
| Southern | 93 | 60 | 154 |

Table 37 shows that the CDOP was associated with a total saving of 897 casualty crashes in 2020 and 1,191 in 2021. Of these, 457 and 621 respectively were serious casualty crashes and half of the total crash savings derived from the Brisbane region. Comparing the relative contributions of each CDOP element to the overall savings given in Table 41 showed that between 91% and 93% of the overall program casualty crash savings came from the mobile speed camera program. This is slightly lower than in previous years reflecting the additional crash reductions associated with the RSCT program reducing the proportionate benefits of the mobile camera element in the CDOP as a whole

Using all reported crashes by region and severity in Queensland in 2020 and 2021, the crash savings associated with the CDOP in 2020 and 2021 in Queensland from Table 37 have been converted to percentage savings in total crashes across the state. Results are presented in Table 38 and show an overall reduction in casualty crashes across Queensland of 7.1% and 8.7% for serious casualty crashes in each year respectively and overall reduction in casualty crashes across Queensland of 6.9% and 8.2% for casualty crashes in each year respectively.

Table 38 Percentage savings in total reported crashes associated with the CDOP in 2020 and 2021 by region, crash severity and in total.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** | **Casualty** |
| ***2020*** |  |  |  |
| **All** | **7.1%** | **6.7%** | **6.9%** |
| Brisbane | 12.3% | 10.2% | 11.0% |
| Central | 6.2% | 6.1% | 6.1% |
| Northern | 5.2% | 5.0% | 5.0% |
| South Eastern | 3.9% | 3.6% | 3.7% |
| Southern | 5.9% | 4.5% | 5.3% |
| ***2021*** |  |  |  |
| **All** | **8.7%** | **7.8%** | **8.2%** |
| Brisbane | 14.4% | 11.4% | 12.6% |
| Central | 7.8% | 7.4% | 7.5% |
| Northern | 7.3% | 7.4% | 7.3% |
| South Eastern | 4.1% | 3.9% | 4.0% |
| Southern | 7.2% | 5.5% | 6.4% |

Table 39 gives the community cost savings associated with the CDOP as a whole in 2020 and 2021 based on the cost basis. These correspond to the overall crash savings presented in Table 37 and are derived by summing the estimated cost savings across the individual CDOP elements. As evident from the tables, total community cost savings associated with the CDOP in 2020 were around $503M using the WTP cost basis. The corresponding savings for 2021 were around $678M using the WTP cost basis.

Table 39 Overall crash cost savings associated with the CDOP in 2020 and 2021 by region, crash severity and in total: Willingness to Pay cost basis.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Serious Casualty** | **Minor Injury** | **Casualty**† |
| ***2020*** |  |  |  |
| **All** (Sum of Regions) | **$454,381,407** | **$49,342,695** | **$503,127,019** |
| % Attributable to Mobile Speed Cameras | 95% | 88% | 94% |
| Brisbane | $169,383,617 | $27,766,837 | $194,999,247 |
| Central | $118,961,555 | $7,712,262 | $128,460,761 |
| Northern | $47,055,358 | $2,970,902 | $49,476,998 |
| South Eastern | $39,399,572 | $5,948,288 | $47,388,540 |
| Southern | $79,581,305 | $4,944,405 | $82,801,474 |
| ***2021*** |  |  |  |
| **All** (Sum of Regions) | **$615,021,015** | **$63,863,000** | **$678,286,932** |
| % Attributable to Mobile Speed Cameras | 96% | 91% | 96% |
| Brisbane | $230,295,604 | $35,435,642 | $263,580,038 |
| Central | $165,070,559 | $10,297,945 | $177,155,448 |
| Northern | $68,942,833 | $4,509,542 | $72,903,112 |
| South Eastern | $50,266,877 | $6,860,143 | $59,167,700 |
| Southern | $100,445,141 | $6,759,728 | $105,480,633 |

# Future priorities for the intersection camera program

The final aim of the current study was to establish priorities for the upgrade of existing red-light only cameras to combined speed and red-light cameras as well as for expansion of the combined speed and red-light camera program to currently unenforced signalised intersections in Queensland. Specifically, the project aimed to provide a ranking for the upgrade of the existing 113 red light camera sites to combined speed and red-light enforcement as well as estimate the combined road safety benefits of upgrading all 113 sites. Generation of a priority ranking list for upgrading currently unenforced intersections to speed and red-light enforcement was an additional aim as was identifying a protocol for deciding whether to enforce newly signalised intersections (including those where the intersection was newly constructed).

To achieve these aims, first relevant information on the likely crash reduction benefit of both upgrading red-light only camera sites to combined speed and red-light enforcement and installing combined speed and red-light cameras at currently unenforced signalised intersections was identified from the available literature. Based on this evidence, a protocol for ranking the two signalised intersection types of focus was developed reflecting the likely community costs of trauma reductions at each site from the installation of the combined speed and red-light camera. This was the applied to a 5-year widow of historical observed crash data at each candidate site to provide the final ranking list.

## Crash Effects of New RLSC Installations and RLC to RLSC Upgrades

Section 5.1 of this evaluation has attempted to estimate the crash effects associated with the installation of red-light speed cameras at signalised intersection sites both with and without a red-light only camera currently installed. Due to the limited number of sites available for assessment, results from the analysis lacked statistical robustness. Consequently, it was decided not to use these results as the basis for the ranking protocol developed here. Instead, a literature search was undertaken to find the most relevant estimates of the likely crash benefits associated with installation of combined speed and red-light enforcement cameras. Criteria for selecting relevant estimates from the literature included an Australian study reflecting local practice for signal installation and phasing and being based on the assessment of crash effects over a large number of sites to ensure the estimates were both robust and likely to be able to be generalised to the broader Queensland context.

### RLC to RLSC Upgrade

As part of its Automated Traffic Enforcement program, Western Australia converted the majority of its older red light only cameras to combined speed and red-light cameras. In total, 25 red-light only cameras were converted to red-light speed cameras over a 2-year period. Crash effects associated with the program were reported in Newstead et al (2015). This study represents the most comprehensive evaluation of red-light to combined red-light speed camera upgrades conducted anywhere in Australia. The number of sites studied and the period of available after upgrade crash data was also sufficient to produce statistically robust estimates of the crash effects associated with the upgrade. Table 40 summarises the estimated crash risks at sites with the RLSC upgrade relative to those with only an RLC. Relative risks are given by crash severity along with the statistical significance of the estimate and 95% confidence limit.

Table 40 shows a differential effect of RLC to RLSC upgrade on crashes by severity with a 37% crash reduction estimated to be associated with serious casualty crashes compared to 28% for all casualty crashes. This result is consistent with the notion of the speed enforcement component being associated with a reduction in crash severity at enforced sites. This estimates in Table 40 have been used in developing the ranking protocol for RLC to RLSC upgrades applied to the 113 current RLC sites in Queensland.

Table 40 Estimated relative risks associated with upgrade of RLC to RLSC enforcement at signalised intersections

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Crash Severity** | **Relative Risk** | **Sig.** | **95% Lower Confidence Interval** | **95% Upper Confidence Interval** |
| All Crashes | 0.823 | <0.001 | 0.765 | 0.885 |
| Casualty Crashes | 0.823 | 0.018 | 0.7 | 0.967 |
| Serious Casualty Crashes | 0.633 | 0.024 | 0.426 | 0.943 |

### New RLSC Installations

A study by Budd et al (2011) estimated the crash effects associated with the installation of RLSC at previously unenforced signalised intersections in Victoria. Base on the analysis of RLSC installations at 77 signalised intersections in Victoria, the study represents the most comprehensive available in Australia covering the largest number of sites with adequate post implementation data to achieve statistically robust results.

Table 41 summarises the estimated relative risks of crashes at sites following RLSC installations compared to intersections with no enforcement by crash severity level taken form Budd et al (2011). Estimates were derived for all crash types as well as for red light specific crashes including right turn against and straight through crossing path (RTSCP). Unlike the RLC to RLSC upgrade, this study did not find differential effects of the treatment by crash severity. It did find stronger effects on the crash types associated with red light running, indicative of the enforcement being more effective on the target crash types than crashes overall. These estimates were used in ranking the potential crash savings from upgrading currently unenforced signalised intersection in Queensland to RLSC enforcement.

Table 41 Crash effects associated with RLSC installations at previously unenforced signalised intersections.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Crash Severity** | **Relative Risk** | **Sig.** | **95% Lower Confidence Interval** | **95% Upper Confidence Interval** |
| All Crashes |  |  |  |  |
| Casualty Crashes | 0.74 | 0.001 | 0.84 | 0.65 |
| Serious Casualty Crashes | 0.74 | 0.001 | 0.84 | 0.65 |
| RTSCP |  |  |  |  |
| Casualty Crashes | 0.56 | 0.001 | 0.69 | 0.46 |
| Serious Casualty Crashes | 0.56 | 0.001 | 0.69 | 0.46 |

## Development of a site ranking formula

Development of a ranking protocol for prioritizing RLC to RLSC upgrade or RLSC installation at currently unenforced signalised intersection types had a number of requirements. These were: the need to represent and differential effects of the camera installations on crash outcome by crash severity, to represent the effects of cameras on specific crashes where relevant, be based on actual crash history at signalised intersections, be comparable both between the upgrade types being considered (RLC to RLSC and unenforced to RLSC) and with the broader evaluation results for all other camera types in the CDOP. Based on these needs, similar but slightly different ranking protocols were developed for the two upgrade types being considered. However, comparability between the rankings of two types of upgrade were maintained by deriving a measure that represented the annual social cost savings through expected crash savings at each site based on the effectiveness estimates from the literature.

To facilitate the application of site priority ranking for both upgrade types, real crash history was required over a sufficient period to be representative of the current crash risk at each site. A five-year period was determined to be adequate. Crashes needed to be categorised by severity consistent with the severity levels at which the evaluation evidence was presented. In addition, crash type analysis was also required to identify RTSCP crashes for those sites with no current enforcement in order to apply the crash specific relative risk estimates of Table 41.

### RLC to RLSC upgrade ranking process

Available estimates of crash effects for the RLC of RLSC upgrade only related to all crash types combined but separate estimates of effectiveness were available for serious casualty crashes and all casualty crashes. Reflecting this, the ranking formula was based around applying the estimates by crash severity to the total crash count at current RLC sites. Using the relative risks from Table 40, KSI and total casualty crash savings predicted at each RLC site were estimates as:

Here, KSI(Count) and Casualty(Count) are the average annual counts of fatal and serious injury and all casualty crashes respectively in the data history period studied. Minor injury crash savings were then calculated as the difference between the KSI and all casualty savings. For some sites, the estimated casualty savings were less than the KSI savings. This occurred for sites that had a particularly high proportion of KSI crashes in their total casualty crash count (much higher than the set of sites from which the effectiveness estimates were obtained). In this case, the minor injury savings were set to zero and the total crash savings were assumed to be all KSI crashes to ensure consistency in the ranking formula.

The next step was to calculate the overall community cost savings for each site. This was achieved by multiplying each of the KSI and minor injury savings estimates by the corresponding community crash cost estimates used elsewhere in the evaluation and documented in Table 4. That is:

Since non-injury crashes are not recorded in Queensland, minor injury savings could not be estimated.

Finally, the sites were ranked for priority treatment in order of estimated community cost savings from largest to smallest. Community cost savings estimated from treating each site could be compared directly to cost savings from other elements of CDOP estimated elsewhere in this evaluation. A notional benefit to cost ratio could be calculated for the treatment of each site by multiplying the annual community cost savings by the treatment life in years (or more precisely calculating the present value of the annual stream of cost savings benefits over the life of the treatment) and dividing this by the cost of implementation of the site treatment.

### Unenforced to RLSC upgrade ranking process

Assigning rankings to sites for the upgrade from unenforced to RLSC is similar in concept to the RLC to RLSC upgrade ranking process. The key difference was the availability of relative risk estimates for the unenforced to RLSC upgrade related to all crash types and for RTSCP crashes. As noted, the estimates of effectiveness were the same for serious casualty crashes and all casualty crashes. The ranking formula was based around applying the estimates by crash severity to both the total crash count and the RTSCP crash count at currently unenforced sites. Using the relative risks from Table 41, KSI and total casualty crash savings predicted at each RLC site were estimates as:

Again, KSI(Count) and Casualty(Count) are the average annual counts of fatal and serious injury and all casualty crashes respectively in the data history period studied. Minor injury crash savings were again calculated as the difference between the KSI and all casualty savings with zero assigned when the estimated casualty savings were less than the KSI savings. The same process was repeated for RTSCP crashes.

Depending on the particular site the RTSCP savings could be larger or smaller than the all crash savings. For consistency, the larger of the two estimates was taken for the ranking which is consistent with the concept that some sites may have a higher proportion of RTSCP crashes as the primary crash type, and hence addressed by the red-light enforcement component, whilst other sites the crash types may be more general and hence addressed more by the speed enforcement component.

Calculation of the overall community cost savings for each site was completed as per the RLC to RLSC upgrade using the maximum estimated saving across the two crash types considered for each of the KSI and minor injury estimates. Again, the sites were ranked for priority treatment in order of estimated community cost savings from largest to smallest. Community cost savings estimated for the treatment of unenforced sites can be compared directly with those for the current RLC sites to determine whether an upgrade or treatment of an unenforced site will bring greater road safety benefit.

### Data Used for ranking

Crash data from Queensland over the years 2015 to 2019 was used to estimate the site rankings. Although crash data was available to the end of 2021 for the broader evaluation, the last 2 years of data were influenced by the COVID-19 epidemic and hence were not considered as likely to represent the longer-term crash history at each signalised intersection.

RLC sites were identified in the data provided for the broader evaluation and crashes occurring at each site identified through spatial mapping. Each of these sites had a currently operation RLC. The unenforced signalised sites refer to signalised intersections that currently have no red light or red-light speed camera enforcement. Sites that previously had an RLC that had since been decommissioned were not included in the analysis as it was assumed they were considered inappropriate for enforcement. To be identifiable as a signalised intersection site, unenforced intersections needed to be coded as controlled by traffic signals and have a value for the variable "Crash street Intersecting" (indicating the site was an intersection) or a TMR derived ‘Intersection site ID’ which was a code given to crashes within a set distance of a signalised intersection (this code was not the ‘intersection ID’ variable reported in crash data).

There were some intersections with signals not identified by the TMR site id code hence the need to employ the first criteria for identification. Each TMR site ID code was given a unique road name description matched from other site data. Some attempt at standardising the intersection name for these un-coded intersections was made however it is possible that there was some variation in names for a unique intersection. Intersections identified using the first criteria by definition had identifying road names.

Crash data at each signalised intersection for both the RLC and unenforced sites were tabulated by crash severity and crash type where applicable as totals over the five-year period of data. For the unenforced intersections (unique by allocated names) those with less than 6 crashes (average of 1 or fewer per year) were excluded from the ranking process. This left 441 signalised intersections for ranking out of a total of over 3000. The sites exclude from consideration are unlikely to warrant RLSC enforcement given their very low crash volumes. The process of determining community cost savings from RLSC upgrade or installation described in the sections above was then applied and the rankings of sites determined by sorting the resulting estimates from largest to smallest.

## site ranking list

### RLC to RLSC Upgrade

Results of applying the ranking process to current RLC sites are detailed in Table 42 for the top 40 ranking sites. The full list of sites is provided in the Appendix Section 8.5 including the 5-year KSI and minor injury crash savings estimated.

Table 42 Priority rankings for upgrade of current RLC sites to RLSC enforcement.

|  |  |  |
| --- | --- | --- |
| Red Light Camera Site Identification Number | Intersection Name | Estimated Community Cost Reduction for Ranking |
| 92 | East St & Limestone St | $771,849.04 |
| 42 | Beams Rd & Gympie Arterial Rd (1/04) | $701,099.60 |
| 506 | Gateway Art Rd Ramp & Old Cleveland Rd | $685,352.81 |
| 15 | Duke St/Prince St & Juliette St | $534,357.03 |
| 16 | Ipswich Rd & Venner Rd/Waterton St | $534,357.03 |
| 9 | Compton Rd & Gowan Rd | $496,257.70 |
| 121 | Cottesloe Dr & Southport - Burleigh Rd | $378,089.97 |
| 206 | Kings Rd & Woolcock St/Townsville Port Rd | $356,238.02 |
| 301 | Cairns Western Arterial Rd (Pease St) & Hoare St/Moody St | $356,238.02 |
| 511 | Main St & Vulture St | $338,723.00 |
| 103 | Ashmore Rd & Southport - Nerang Rd | $330,849.61 |
| 461 | Bourbong St/Mulgrave St/Bundaberg - Bargara Rd & Isis Hwy | $311,166.12 |
| 507 | Albion Rd & Lutwyche Rd | $307,229.43 |
| 8 | Kessels Rd (Not Griffith Art. Rd) & Orange Grove Rd | $303,292.73 |
| 106 | Gold Coast Hwy & Labrador - Carrara Rd | $303,259.31 |
| 104 | Gold Coast Hwy & Southport - Nerang Rd | $299,356.03 |
| 12 | Boundary St & Leichhardt St/St Paul's Tce | $299,356.03 |
| 36 | Dawson Rd & Klumpp Rd & Logan Sub-Arterial Rd (U90) | $296,865.02 |
| 451 | Ferry St & Maryborough - Cooloola Rd (Alice St) | $296,865.02 |
| 152 | Bridge St & Holberton St | $296,865.02 |
| 1 | Gympie Arterial Rd (1/04) & Rode Rd | $291,449.22 |
| 37 | Leopard St & Stanley St | $275,702.44 |
| 411 | Nicklin Wy & Jessica Blvd/Kensington Dr | $271,765.74 |
| 82 | Anzac Ave & Victoria Ave | $252,082.26 |
| 45 | Lutwyche Rd & Northey St | $248,145.56 |
| 24 | Bennetts Rd & Crown St/Macrossan Ave | $244,208.86 |
| 203 | North Townsville Rd & (Boundary St & Woolcock St & Charters Towers Rd) | $244,208.86 |
| 204 | Anne St & Ross River Rd | $244,208.86 |
| 463 | Heidke St/Johanna Blvd & Takalvan St/Isis Hwy | $240,272.17 |
| 253 | Fitzroy St & George St | $237,492.01 |
| 254 | Bolsover St & Fitzroy St | $237,492.01 |
| 452 | Pallas St & Walker St | $237,492.01 |
| 151 | James St & Kitchener St | $237,492.01 |
| 94 | Chermside Rd & Brisbane Rd & Glebe Rd | $237,492.01 |
| 509 | Griffith Arterial Rd (U20 -1/95) & Mains Rd | $232,365.36 |
| 126 | Discovery Dr/Town Centre Dr & Gold Coast Hwy | $220,555.27 |
| 18 | Cornwall St & Ipswich Rd | $212,681.87 |
| 405 | Mooloolaba Rd & Sugar Rd | $208,745.18 |
| 116 | Labrador - Carrara Rd & Napper Rd | $204,808.48 |
| 84 | Nathan Rd/Chelsea St & Redcliffe Rd | $204,808.48 |

Based on the list of sites in Appendix Section 8.5, if all 113 current RLC sites were upgraded to RLSC enforcement, a total of 21 KSI crash and 14 minor injury crashes were estimated to be saved over a 5-year period corresponding to an annual community cost saving of $19M. Of the total potential community cost savings, 50% could be realised by treating the 25 highest ranked sites in Table 42 whilst 75% could be realised by treating the 46 highest ranked sites. This demonstrates the diminishing returns of RLSC upgrade when working down the list of ranked sites.

### New RLSC installations at existing signalised intersections

Applying the ranking criteria to the currently unenforced signalised intersection set yielded the results summarised in Appendix Section 8.6. Results for the top 40 ranked sites are shown in Table 42 in rank order priority. Sites without an Intersection ID are those that have been identified using the intersection control status and road names in the crash data.

Table 43 Priority rankings for RLSC enforcement of currently unenforced signalised intersections.

|  |  |  |
| --- | --- | --- |
| INTERSECTION ID | Intersection Name | Cost Reduction |
| M7061 | Dances Rd & Pumicestone Rd | $760,759.62 |
| M5205 | City Rd & Logan St | $718,935.14 |
| M5028 | Nerang - Broadbeach Rd & Southport - Burleigh Rd | $668,251.12 |
| M5365 | Hope Island Rd/Tambourine Oxenford Rd Deviation (Tamborine - Oxenford Rd) & Old Pacific Hwy/Heathwood Dr | $643,536.66 |
|  | Larsen Rd & Redlynch Connector Rd | $640,646.03 |
| M6037 | Taylor St & Tor St (Toowoomba - Cecil Plains Rd & Warrego Hwy) | $637,966.11 |
| C5133 | Clifford St/Paradise Island & Gold Coast Hwy/Remembrance Dr | $604,159.45 |
| L2517 | Chambers Flat Rd & Waratah Dr | $592,594.01 |
| M5217 | Beaudesert - Beenleigh Rd & Tallagandra Rd | $592,594.01 |
| M1396 | Gateway Art Rd Ramp S/U & Wynnum Rd | $590,803.74 |
| M2733 | Brisbane Rd & Church St | $556,997.08 |
| M5011 | Anne St/Minnie St & Southport - Nerang Rd | $556,997.08 |
| M7044 | Beerburrum Rd/Old Gympie Rd & Pumicestone Rd | $556,107.43 |
| B0161 | Gipps St/Kennigo St & St Pauls Tce | $547,210.94 |
| L5470 | Distillery Rd & Fryar Rd/George St overbridge | $544,531.02 |
| C5534 | Christine Ave & Robina Town Centre Dr | $524,958.74 |
| M7057 | Bruce Hwy Ramp S & Deception Bay Rd/New Settlement Rd | $513,838.13 |
| M1608 | Beaudesert Rd (Use After 1/95) & Griffith Arterial Rd (U20 -1/95) | $502,616.19 |
| B0077 | Ann St & Gipps St/Bradfield Hwy/Kemp Pl | $495,801.52 |
| M1119 | Gympie Arterial Rd & Webster Rd | $490,018.80 |
| B0706 | Compton Rd & Gateway Arterial Rd | $485,814.19 |
| M1721 | Progress Rd & Western Arterial Rd (1/04) | $485,814.19 |
| B0180 | Appleby Rd/Maundrell Tce & Rode Rd | $484,924.54 |
| M7006 | Morayfield Rd (Burpengary - Caboolture Rd) & Elliott St/Esme Ave | $479,141.82 |
| M1524 | Cannes St/Pacific Mwy Ramp & Marshall Rd | $466,241.91 |
| M1657 | Beaudesert Rd & Algester Rd/Illaweena St | $457,938.03 |
| L2409 | Loganlea Rd & Moloney Rd/Short St | $456,455.77 |
| M6006 | James St & West St | $456,455.77 |
| C5601 | Christine Ave & Scottsdale Dr | $442,655.24 |
| M1459 | Griffith Rd/Griffith Arterial Rd (U20 -1/95) & Troughton Rd | $440,589.88 |
| M1420 | Logan Rd & Warrigal Rd/Pacific Mwy Ramp | $436,872.52 |
| M2428 | Brisbane - Beenleigh Rd & Compton Rd | $434,807.16 |
|  | Bruce Hwy Eastern Service Rd (01/09) & Deception Bay Rd | $414,631.29 |
| B0158 | Murphy Rd & Robinson Rd | $413,741.65 |
| M1611 | Beaudesert Rd & Mortimer Rd | $413,741.65 |
| M2434 | Kingston Rd & Wembley Rd (1/95) | $410,092.70 |
|  | Boundary Rd & Diamond Jubilee Way | $407,958.93 |
| C5360 | Hinkler Dr (7/13) & Pappas Way | $404,845.16 |
| M5456 | Franklin Dr/Gold Coast - Springbrook Rd & Somerset Dr | $404,845.16 |
| M1460 | Griffith Arterial Rd (U20 -1/95) & Orange Grove Rd | $402,176.21 |

Like the RLC upgrade sites, there are diminishing returns for installing RLSC enforcement at currently unenforced intersections. Of the 441 unenforced sites ranked, 50% of the total annual community cost savings estimated across all 441 sites ($106M) would be obtained from enforcing the 139 highest ranked sites. In comparison to the RLC upgrades, installation of RLSCs at currently unenforced sites was estimate to yield greater road safety benefits per site when treating the highest ranked site. Treating the 40 highest ranked currently unenforced sites was estimated to yield aggregate community cost savings of $20M compared to cumulative savings of $13M for upgrading the top 40 ranked current RLC sites. Whether a cost benefit analysis would show the same relative benefit is unknown since the relative costs of RLC upgrades versus new installations of RLSC at unenforced sites was not available for the study.

### RLSC enforcement at newly signalised intersections

A further requirement for the site ranking was to establish general criteria that could be applied to newly signalised intersections, whether the intersection was previously existing or newly constructed, to determine if incorporating a RLSC at the intersection from time of signalisation would be warranted. Given there will be no prior crash history at new sites, it is not possible to develop criteria for treatment based on this measure. An alternative wold be to utilise a risk model to predict likely crash outcomes at the intersection. Such models are notoriously difficult to construct for urban areas where there is a large range of contributing risk factors. For example, Stephan and Newstead (2012) constructed a risk model for urban strip shopping centres that contained 18 risk factors that were statistically significant estimators of crash numbers. Currently there is no adequate intersection risk model that will accurately predict crash outcomes. Even if one existed, information on all the key risk factors would need to be made available for existing sites to calibrate a model for Queensland. These are not generally available in administrative data and would need to be collected on a site by site basis. In addition, measure of all factors would need to be collected for all newly signalised intersections.

One factor that is generally strongly related to crash risk is traffic volumes. Traffic volumes were a selection of 159 currently unenforced signalised intersection sites which had been ranked and also had available traffic volume data from nearby traffic survey sites. To investigate the feasibility of using traffic volume as a proxy for likely high ranking as a candidate RLSC site, the estimated community crash cost saving associated with RLSC installation at the 159 sites was plotted against average daily traffic volumes for each site collected over the same time period as the crash data. The resulting plot is shown in Figure 17 along with the logarithmic best fit average curve.

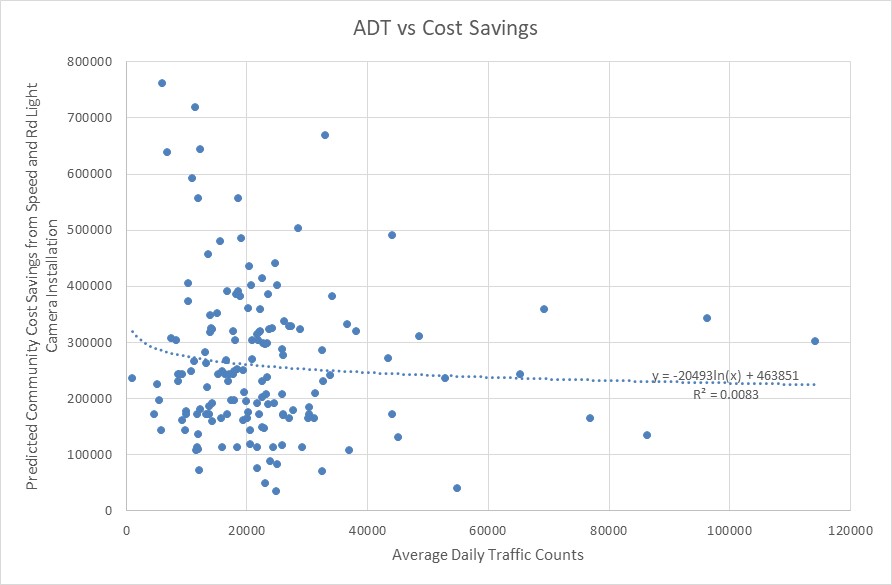


Figure 17 Community cost savings from RLSC installation at currently unenforced sites versus traffic volumes

As evident from Figure 17, the relationship between daily traffic volume and predicted community cost savings from RLSC installation at currently unenforced sites is weak (with an r-squared value of less than 1%). This shows that traffic volume is not an adequate predictor of future crash risk at signalised intersections and hence cannot be used as a proxy for prioritising RLSC at newly signalised intersections.

Based on this analysis there is no current reliable way of assessing whether a newly signalised intersection should include RLSC enforcement from the time of signal installation. Given the number of existing high-risk sites that either have only an RLC or are currently unenforced, it is likely that focusing on these sites for RLSC installation as a priority will give the greatest road safety gains. Newly signalised sites should be monitored post signal installation and ranked against existing candidate sites using the ranking procedures described above to determine is RLSC enforcement is appropriate at a later date after signalisation. Best practice design rules for new installation of new signals should also be followed, including full control of turns, to ensure all other risk factors apart from red light running and speeding are adequately addressed.

## Post ranking process

Ranking of signalised intersections for RLSC enforcement is a first step identifying potential candidate sites for enforcement. This process is, however, only a first step in an integrated process for final determination of whether a candidate site is ultimately suitable for RLSC enforcement. A next step is to undertake a detailed analysis of crashes occurring at a candidate intersection in terms of crash types and manoeuvrers being undertaken before the crash and signal phasing. This allows determination of whether there are other factors that need to be addressed to improve safety at the intersection that a RLSC is unlikely to address (such as lack of full turn control) and which leg or legs of the intersection are best to enforce to address the identified crash problem. A final step in determining site suitability for enforcement is a physical site inspection to ensure the physical location requirements for camera installation are supported at the sire and preferred intersection leg identified through the detailed crash analysis.

# Discussion

The aim of this project was to estimate the road safety benefits, both crash savings and cost savings to the community associated with the Queensland Camera Detected Offence Program (CDOP) in the calendar years 2020 and 2021. Effects were estimated overall, by CDOP element, by police region and by crash severity. Over the life of CDOP, two specific evaluation frameworks have been developed. The first was developed specifically to measure the road safety impacts of the mobile speed camera program in Queensland (Newstead and Cameron 2003). With the expansion in scope to consider fixed speed camera elements, a new evaluation framework was developed (Newstead 2012) which carried over elements of the original mobile speed camera evaluation framework adding additional constructs to accommodate the fixed elements of CDOP. Significant changes to the operation of the mobile speed camera component of CDOP and a need to explicitly evaluate the individual impact of these changes led to the development of a revised evaluation framework for estimating the effects of the CDOP in 2018 and 2019 (Newstead et al., 2021). A specific feature of the new evaluation framework for CDOP is the capacity to estimate crash effects related to specific sub-components of the mobile speed camera program in Queensland.

The following sections consider the success of the current framework in assessing the road safety benefits of CDOP, particularly in the calendar years 2020 and 2021. Strengths and limitations of applying the framework are considered along with the significance of the results from applying the framework in terms of the effectiveness of CDOP and implications for future operation and expansion of the program. Requirements for future evaluation of the program are also considered.

## Crash and community cost impacts by camera type

### Intersection cameras

The RLC element of the CDOP has been in operation in Queensland for over 20 years meaning there was a large number of sites and extensive crash history on which to base the analysis. Consequently, the evaluation results for the 105 operating RLCs are highly robust. Initial evaluation of RLC camera crash effects by Newstead and Cameron (2012) showed particularly strong associated reductions in intersection crash types specifically targeted by RLCs (RR = 0.58, 95% C.L. 0.48-0.69, p<0.00005). In contrast to previous studies, the initial evaluation showed no increase in rear-end crashes possibly as a result of the close proximity of each of the RLC sites to a mobile speed camera site. General speed compliance at RLC enforced intersections could prevent rear-end crashes. The absence of RLCs not in close proximity to a mobile speed camera site prevented explicit assessment of the potential synergistic effects of the mobile camera site on RLC crash effects. Estimated overall effects of RLCs on all intersection crashes from this updated evaluation were lower than those of the previous two evaluations (RRcasualty = 0.84, 95% CI: 0.76 to 0.92 & RRcasualty = 0.84, 95% CI: 0.75 to 0.91). This is possibly due to decommissioning of some RLC sites, or the availability of more reliable intersection identifier codes for this analysis allowing more specific crash selection for sites where RLCs are located. However, when only targeted (right-through) crashes were examined, the casualty relative risk associated with RLCs from this analysis was not statistically different from the estimates of the previous two analyses. This suggests an increase in non-targeted crash types at enforced intersections in recent years.

Despite the large number of sites on which the RLC evaluation was based, even the extended crash data available for this evaluation were insufficient to allow estimation of yearly crash effects associated with the program. Consequently, only average crash effects over the post-implementation period were estimated and it was assumed that the average crash effects applied equally over each post-intervention year in estimating the 2020 and 2021 crash effects associated with the RLCs. This assumption is probably not unreasonable given RLCs are a static and generally highly visible technology which should achieve stable crash effects after an initial short familiarisation period. The estimated crash effects translated to annual savings of 24 casualty crashes associated with RLCs per year of which 9 were serious casualty crashes, translating to an annual saving to society of around $9M (WTP).

Thirty-five RLSCs, all but fifteen being upgrades of previous RLC only sites, were considered in the analysis. Statistical analysis power for the RLSCs was low due to the large proportion of recently commissioned cameras with limited after installation periods. Consequently, analysis results for RLSCs were inconclusive. Analysis by crash type revealed a 27% (p = 0.01) reduction in casualty right-through crashes but a statistically significant 23% (p=0.03) increase in rear-end crashes. The analysis of similar installations across a wider number of sites in Victoria (Budd, Scully et al. 2011) has shown new installations of these cameras to reduce crashes across the whole of the intersection installed by around 25% with no significant increase in rear end crashes estimated. Based on the estimated effects of upgrades to 21 RLC and fifteen new installations of RLSCs (regardless of statistical significance), this evaluation found RLSCs to be associated annual savings of three serious casualty crashes with an annual community cost saving of $2M (WTP). These results should be treated with caution given the lack of statistical rigour in the estimates.

### Fixed mid-block speed cameras

Ten digital fixed spot mid-block speed cameras were active during 2020 to 2021. In addition, two PtP speed camera systems were also operating during this period including both average speed and in spot speed enforcement modes. One PtP system on the Toowoomba Second Range Crossing only operated for the last three months of the study period providing insufficient time post-camera for a robust analysis. The second fell on a segment of the Bruce Highway between Elimbah and the Glass House mountains. Fixed spot cameras were also operational in 2020 and 2021 in three tunnel sections: the Clem 7, Legacy Way and Airport-Link.

Despite the additional post camera installation crash data available for this evaluation of CDOP compared to previous evaluations, evaluation results for the non-tunnel fixed mid-block spot speed cameras remained inconclusive. Although the overall crash effect estimates for this camera type achieved statistical significance, difficulty in control selection, the relatively small number of installations and the types of roads on which they are sited contributed to less confidence in these results. An evaluation of similar camera types on a major Victorian freeway (Newstead et.al., 2019) estimated statistically significant crash reductions of around 30% so it is likely that the same cameras in Queensland also produce road safety benefits. However definitive effect estimates in Queensland will need to wait for future evaluation with greater crash history at current sites and perhaps further installations.

In contrast to previous evaluations of CDOP, statistically robust estimates of casualty crash effects associated with PtP cameras were obtained in this study. Casualty crash reductions of 35% were estimated, greater than the effect estimated for the Hume Highway system in Victoria (Newstead et. al., 2019). The higher estimated crash savings is possibly due to trailer cameras operating in the PtP zone of influence during the 2020 to 2021 period. Given the length of road covered by this system, this corresponded to a saving of 20 casualty crashes annually, of which 4 were serious casualty crashes with associated community cost savings (willingness to pay) of around $7.3M per annum.

Estimates of tunnel fixed speed camera effectiveness were obtained through cross sectional comparison of the Clem 7 and the Airport-Link routes with the Port of Brisbane Motorway and the Southern Cross Way. These control sections, although not tunnels, had suitable crash volume data available, were similarly located, had similar speed limits and freeway traffic characteristics. The comparability of these sites might be questionable given that they are not tunnels however the broad characteristics of the roads are very similar. The comparison is further complicated by the apparent lack of recent years of traffic volume surveys with the figures quoted in these last years the same as for recent previous years. It seems unlikely that traffic flows remained at these levels in 2020 and 2021 due to the likely impact of the COVID-19 pandemic on travel patterns. Further efforts need to be made to obtain accurate traffic volume data for these roads to use in future updated of the CDOP evaluation.

Based on the comparisons made, the Clem 7 and Airport-Link fixed speed cameras were found to be associated with a substantial (74%) reduction in casualty crashes. This is likely to reflect high speed compliance in the tunnels related to the likely extensive knowledge of the cameras by drivers. To some degree, the crash reductions might also reflect the tunnel environment which is perceptually different to regular motorways due to being enclosed. Regardless of the cause, analysis suggests the operating environment in the tunnels has achieved a high level of safety. Whether this is entirely due to the speed cameras is unknown but these are likely to play an important part. The total contribution of the tunnel cameras in terms of casualty crashes saved per year is 11 of which 5 were serious or fatal corresponding to economic savings (willingness to pay) of $3.9M. These estimated savings are broadly comparable with a PtP system even though these cameras do not operate PtP but are possibly spaced closely enough to achieve similar coverage.

TMR has noted that for all fixed speed camera modes there is sometimes a significant delay between installation of the camera and its activation when enforcement commences. Presented results are based only on activation date because installation date data were only available for a selection of fixed digital speed cameras and consequently associated crash data in the installation to activation period was limited. As noted, there may be some unaccommodated crash effects in the period between installation and activation which may have contaminated the defined pre-activation data period. Consequently, crash effects for the fixed camera elements to which this delay applies may be slightly underestimated. This underestimation is likely to be small given the proportion of time that the ‘installation to operation’ period makes of the total, extensive, pre-activation period. Installation dates were not provided for analogue fixed speed cameras and could not be used for RLSCs. The installation to activation period for the five digital speed camera sites analysed, and not in tunnels, ranged from only one to two months, which is less than 1% of the pre-activation observation time. Activation and signage were coincident for the tunnel digital cameras.

### Road Safety Camera Trailers

Mobile trailer speed camera operations began December 22, 2016 with targeted operations. Trailer operations were extended to school zone and roadwork speed enforcement in 2017 (January and April respectively). Operations during 2020 and 2021 were identified with 61 different six-digit site numbers. Up to seven operations were carried out for each site number. More than a third of these sites were dropped from the analysis due to very low crash numbers at the enforced sites to ensure the robustness of the analysis regression model. An overall 40% reduction in serious casualty crashes (p=0.003) and a 34% reduction in minor injury crashes(p=0.0001) was estimated at times and locations when the cameras were operational. Reductions in crash risk were estimated to be associated with all three operation types, however the estimates only reached significance for crashes of targeted operations (37% casualty crash reduction, p< 0.0001). Effectiveness differed significantly between police regions and was greatest in the urban and rural Southern regions and in the Central Rural regions. State-wide, annual casualty crash savings associated with RSCT was estimated at 38, 17 of which were fatal or serious. This savings translated to $15M using WTP costs. The crash savings from RSCTs make up about half of all fixed camera savings (in terms of crashes or in terms of WTP costs) and 58% of fatal and serious crash savings estimates. This makes them a highly valued part of the fixed camera network.

### Mobile speed cameras

In estimating the crash effects associated with the mobile speed camera component of the CDOP, it was originally planned to use the estimated relationships between enforcement hours and crash effects estimated by Newstead et al (2021). Due to the increases in hours of mobile speed camera operation hours in 2021 potentially extrapolating the previous models beyond their range of calibration, it was decided to recalibrate the relationships between mobile speed camera hours of enforcement and crash risk for each mobile camera type and broad crash severity category considered. Encouragingly, the statistically significant relationships found in the previous two analyses were consistent in magnitude and significance with those in this update. Specifically, in both recalibrations, overt car-based operation hours had an association with all casualty crash risk in rural and urban areas, whilst covert car-based operations had an association with all casualty crash risk in urban areas. Portable/LTI operation hours had an association with serious casualty crash risk in urban areas. The relativity of effects between camera types and areas of operation were also similar to previous updates. Estimated crash reductions per hour of enforcement in rural areas were greater than urban areas, covert operations produced greater crash reductions per hour enforced compared to overt operation and portable / LTI operations were associated with the lowest crash reductions per hour enforced.

There were some differences in the relationships between enforcement type delivery and cash outcomes between this study and previous updates. Covert car-based operations association with casualty crash risk in rural areas was of the same magnitude in this update, but in contrast to the previous update, this estimate did not reach statistical significance this time. This update was also able to provide some estimates of statistical significance not reached in the previous updates: the estimates of the association of *casualty* crash risk and portable/LTI operation hours reached statistical significance, both overall and in urban areas; and the estimates of the association of serious *casualty* crash risk and overt car operation hours reached statistical significance, both overall and in rural areas.

Although the estimated relationships between mobile speed camera operation hours and crash risk were generally consistent between this evaluation update and the previous evaluation estimating CDOP effects in 2018/2019, the magnitude of the parameter estimates has changed slightly. Whilst the change is not outside of the bounds of statistical confidence on the estimates, and were virtually identical for some (e.g. covert-car-urban), the overt parameter estimates are slightly smaller, and the covert-car-rural parameter estimates did not reach significance. This meant the estimated savings associated with the mobile speed camera program are slightly lower than that reported in the previous study for comparable years. The savings increases arising from the now significant portable/LTI association did not fully offset this decline.

Noting these changes, an important aspect of interpreting the impacts of the mobile speed camera program then is examining the estimated relative effects of the program from year to year. For this reason, the recalibrated models were used to estimate mobile camera crash effects for all years from 1999 where operations data was available (Figures 10-15). Comparing the relative crash effects by year, it was evident that the largest crash reductions associated with the mobile speed camera program were estimated for 2018 and 2019, reflecting the significant increase in mobile speed camera operational hours in these years compared to previous years. Overall casualty crash savings and associated economic savings in these years were over 22% higher than for 2017, quantifying the additional road safety benefits of the increased enforcement hours. Using the same calibration and a 2021 cost base, the 24% drop in economic savings from 2018 and 2019 to 2020 and 2021 was most likely attributed to a change in the distribution of operation types and the distribution of locations used. Changes to the total hours of operation, which overall (including portable/LTI) were only 5% lower in 2021 and 2021 than for 2018 and 2019, are less likely the cause of the reduced trauma savings associated with the mobile camera program in the most recent 2 years of evaluation. Although operational hours were reduced in 2020, most likely due to COVID-19 related effects, total operational hours were amongst the highest recorded for the program in 2021. Yet in 2021 the overall crash effects associated with the program were lower than estimated for 2019 due to the change in operational mix, specifically a reduction in the hours (and percentage) of covert car-based operations delivered.

Analysis shows the size of the crash problem in urban areas of Queensland is greatest and the portable / LTI cameras are well targeted to fatal and serious crash prevention which represents the greatest cost burden to society. However, analysis also demonstrated that covert car-based cameras have greater crash reduction benefits per hour of enforcement than portable / LTI cameras. Hence, this analysis suggests that reducing enforcement hours with covert car-based cameras and with portable / LTI cameras may have resulted in the observed reductions in road safety benefits of the mobile speed camera program in 2020 and 2021.

Another factor impacting estimated program crash effects is crash coverage. Fatal crash coverage of the mobile speed camera program continued to decrease (see Figure 16). If fatal crash savings are a particular focus of the CDOP, as opposed to serious and minor injury crashes, analysis demonstrates a need to consider how the program might be expanded in future year through inclusion of additional enforced sites, to better target the fatal crash population in Queensland which appears to becoming more diffuse in areas outside of those currently enforced.

Despite the estimated crash savings from the mobile speed camera component being lower than previous years due to the recalibration and reduced covert and portable hours, the savings associated with this program component are still substantial and comprise the bulk of benefits associate with the CDOP overall at between 88%-96% depending on the crash year and crash severity. As such, the mobile speed camera program remains the most important element of CDOP in delivering the targeted strategic benefits aimed for in the Queensland road safety strategy. With total economic savings from this component being valued at between $474M and $649M in the most recent years, there is little doubt the program remains cost effective and an important contributor to the overall strategic road safety goals in Queensland.

## Overall CDOP Impacts

Reductions in total crash savings across Queensland associated with CDOP in 2020 were estimated to be 7.1% for serious casualty crashes and 6.9% for all casualty crashes. In 2021 was 8.7% for serious casualty crashes and 8.2% for casualty crashes. As noted, the vast majority of these estimated crash reductions (88-96%) are associated with the mobile speed camera program. Translation of the percentage crash savings into absolute crash savings was achieved by applying the estimated percentage crash savings to the observed crashes at camera sites in 2020 and 2021. This method assumes the camera program is last in the order of factors reducing crashes, operating after other non-camera-based factors, such as other road safety programs or socio-demographic and economic effects, represented by crashes at the analysis control sites. This gives the most conservative estimates of absolute crash savings associated with CDOP but is the most defensible since it does not rely on projecting road trauma in the absence of all other factors including CDOP. Using this methodology, it was estimated that CDOP was associated with absolute casualty crash savings of 897 in 2020 of which 457 were fatal or serious injury crash savings and 1,191 in 2021 of which 621 were fatal or serious injury crash savings. Conversion of the estimated crash savings into cost savings estimated annual savings of around $503M in 2019 and $678M in 2021 associated with the program valued using WTP estimates (2021 $). About 91% of the total savings stem from savings in fatal and serious injury crashes which are appropriately the focus of the Queensland road safety strategy.

There was significant variation in estimated CDOP effects between regions of Queensland. By far the greatest effects for the program were estimated in the Brisbane area where many of the fixed speed camera elements are located, and the covert and portable mobile speed camera operations have the highest effectiveness. It is also where the crash density is highest consequently achieving the highest coverage of the crash population.

Overall, evaluation of the Queensland CDOP shows that it aligns closely with the goals and objectives of the Queensland road safety strategy. It aligns specifically on the key safe system pillars of safe speeds and safe people, and has proven to be an effective program with the actions producing measurable reductions in road trauma hence reducing the burden of road trauma on Queensland communities. Estimated overall serious casualty crash reductions associated with the program in 2020 and 2021 of 7.1%-8.7% of the total, represent a significant proportion of the total strategy target reductions of 30-33% reduction in serious casualties by 2021 reinforcing the high value of the program in the context of the broader strategy.

## Future CDOP evaluation

Periodic updating of the CDOP evaluation in future years will be able to estimate the ongoing road safety benefits of the program as well as quantify the impacts any future expansion or enforcement mix changes made to the program. As demonstrated in this evaluation update, regular recalibration of the evaluation models for the mobile speed camera program is also important to derive the most accurate associations between levels of mobile speed camera enforcement and associated crash risk changes. With the potential expansion of camera-based enforcement in Queensland to include enforcement of mobile phone and seatbelt use, there will also be a need to carefully integrate these new elements into the CDOP framework in order to be able to estimate the road safety impacts of this new camera type separately form the existing CDOP elements.

A further area of research identified in the current evaluation is the need to better understand the lack of identified road safety benefits for the fixed mid-block speed camera component of CDOP in this evaluation. Evaluation of similar cameras in Victoria (Newstead et al, 2019) and NSW (ARRB, 2005) has identified significant crash savings associated with this camera type in areas local to the camera. The lack of similar benefit estimated for these cameras in Queensland is incongruent with these earlier studies and warrants further investigation including study of specific siting of these cameras, detailed localised crash patterns and general speed behaviour around the installations.

# Conclusions

The study has estimated the road trauma effects associated with the Queensland CDOP in 2020 and 2021 through application of the most recently developed CDOP evaluation framework which accommodates the multiple modes of camera enforcement in the mobile speed camera component of the CDOP. Applying the framework to the longer period of data has provided more robust estimates of associated crash effects and the links between levels of operation of the mobile speed camera program by specific camera type and observed crash outcomes.

Evaluation results show that the Queensland CDOP was associated with sustained crash reductions across Queensland in the years 2020 and 2021 with correspondingly large economic benefits to the community accruing from its operation. Both fixed and mobile elements of the program produced significant crash reductions. Crash effects associated with RLCs, tunnel cameras, PtP cameras and newly installed RLSCs estimated in the evaluation were robust. In contrast, the evidence of effectiveness for fixed spot speed cameras and for some of the more recently implemented fixed camera types (RLC to RLSC upgrades), remains weaker due to limited post-implementation history and, in particular, a small number of camera installations. Despite the expansion of the number of fixed cameras in use under the CDOP, the mobile camera program continues to produce around 95% of the measured benefits associated with CDOP, reflecting the high proportion of the crash population it covers.

The study provided further evidence on the mechanisms of crash reduction effects associated with the mobile speed camera program. Hours of operation of both overt and covert car-based mobile speed cameras were statistically significantly associated with all casualty crashes, with no difference in association by crash severity. Estimated relationship strengths differed between urban and rural areas with a higher percentage crash reductions per hour of enforcement in rural areas compared to urban areas. Furthermore, covert car-based mobile operations were found to produce higher crash savings per hour of enforcement compared to overt operations. The difference between overt and covert effectiveness varied between urban and rural settings, with covert operations being relatively more effective in urban areas compared to overt operations. Associations between portable / LTI cameras and crash outcomes were only found in urban areas where the level of effectiveness per hour enforced was greater than that of overt car-based operations.

Overall crash reductions in Queensland associated with CDOP were 7.1% for serious casualty crashes and 6.9% for all casualty crashes in 2020 and 8.7% for serious casualty crashes and 8.2% for all casualty crashes in 2021. It was estimated that CDOP was associated with absolute casualty crash savings of 897 in 2020, of which 457 were fatal or serious injury savings, and 1,191 casualty crashes saved in 2021, of which 621 were fatal or serious injury crashes. Conversion of the estimated crash savings into (2021 $) cost savings estimated annual savings of around $503M in 2020 associated with the program, valued using WTP estimates. The corresponding economic savings in 2021 were $678M. About 90% of the total savings stem from savings in fatal and serious injury crashes which are the focus of the Queensland road safety strategy.

Estimated crash reduction for the CDOP in 2020 and 2021 were lower than those estimated for 2018 and 2019 in the previous evaluation. Analysis showed crash and cost savings associated with CDOP in 2018 and 2019 were the greatest of any year of the program being over 22% higher than the previous best year of 2017. This was largely attributable to the significant increase in the hours of mobile speed camera enforcement in 2018 and 2019. There were two key reasons for lower estimated crash savings in 2020 and 2021 compared to the previous two years, both relating to the mobile speed camera program. Mobile speed camera hours dropped in 2020, most likely as a result of the COVID-19 pandemic. Despite mobile speed camera hours in 2021 returning to similar levels achieved in 2019, estimated crash effects associate with CDOP in 2021 were still lower than estimated for 2019. Analysis showed that this was primarily due to the change in the mix of mobile speed camera operation types. Both 2020 and 2021 saw a decline in the proportion of mobile speed camera operational hours that were portable/LTI and covert, both of which were estimated to be the most effective mode of mobile speed enforcement operation to achieve the highest possible crash reductions. Greater road safety benefits of CDOP could be achieve in the future through a return to higher proportions of cover car-based and portable / LTI operations in the mobile speed camera program in preference to overt car-based operations as achieved in 2019 and 2019.

To inform the potential upgrade of current signalised intersections with red light camera enforcement only or no camera-based enforcement to have combined speed and red-light camera enforcement, a protocol for ranking sites for upgrade was established. The protocol developed is based on the community cost savings of crashes estimated to be potentially prevented by installation or upgrade to a combined speed and red-light camera. It was successfully applied to estimate the road safety benefits of upgrading the 113 current red-light cameras to include speed enforcement or installing new speed and red-light cameras at 441 currently unenforced intersections.

# Appendix

## Camera Types

The authors again ask the reader to refer to Newstead and Cameron (2012) for a detailed literature review of camera modes of operation, effectiveness and scope. This section contains a brief summary of camera types as presented in or summarised from Newstead and Cameron (2012). It is also suggested that the Queensland Government speed and red-light camera web page be viewed: <https://www.qld.gov.au/transport/safety/fines/speed/cameras>. The section on trailer cameras is directly copied from this web page.

### Red-light cameras (RLCs)

Red-light cameras have been operational in Queensland since 1991. Prior to December 2012, the majority of fixed RLCs operated on wet film technology. They are designed to detect vehicles infringing a red traffic signal at an intersection. They can enforce both through traffic as well as right turning traffic where there is full or partial control of the right turn phase by the signals. Installation of the camera is such that it generally only enforces one leg of the intersection driven by the need for the traffic signals to be in view of the camera for evidentiary reasons with two photographs of the infringing vehicle being taken to verify it is moving.

Sites for camera placement are understood to be chosen on the basis of high rates of red-light infringing characterised by specific crash types related to these infringements such as right turn against and right-angle crashes. Red-light cameras are placed and operated in an overt manner with the cameras being clearly visible on pole mountings on the roadside. In Queensland there is no accompanying signage to alert motorists of the presence of the camera (apart from eight trial sites). Infringement notices issued from the cameras also clearly denote the location at which the infringement occurred.

The effects of the cameras on crashes are likely to be highly localised to the sites where the cameras are placed. Whether the effects of the camera are localised to the intersection leg on which it is placed or spill over to the whole intersection are not clear. The spill over effects may be related to the use of accompanying signage on other legs warning of the presence of a camera, as is used in Victoria, or the visibility of the cameras from other legs. Primary mechanisms of deterrence associated with RLCs identified in the evaluation studies are the overt physical presence of the camera and accompanying signage and the receipt of a traffic infringement by offending motorists. Given the overt nature of the program, the former is likely to be stronger.

### Fixed spot speed cameras (FSSCs)

Fixed speed cameras are generally used as a black spot type treatment at locations where speeding has been identified as a primary driver of identified elevated crash risk. Effects of fixed spot cameras used in conjunction with high visibility signage have been estimated as highly localised to within 3km of the camera site. High visibility signage has been speculated as the primary mechanism of deterrence and infringement notices issued act as a secondary deterrence for infringing drivers.

Halo effects are expected within one kilometre either side of a CDOP fixed camera. CDOP fixed camera signage is preferably within one kilometre of the camera and preferably includes two (but at least one sign) on all routes to the camera. Extra signage is used when other factors affect the visibility of the signs. The signs are installed in the following order:

1. ‘FIXED SPEED CAMERA AHEAD FOR ROAD SAFETY’ (placed furthest from the camera site)

2. ‘FIXED SPEED CAMERA 24 HOURS FOR ROAD SAFETY’ (placed closest to the camera site)

### Combined red-light speed cameras (RLSCs)

Combined red-light speed cameras at signalised intersections detect both red-light running and speeding infringements. The principal reason for installing these combination cameras is to reduce red-light running crashes and also to reduce the risk and severity of the remaining crashes, particularly rear-end crashes which have been found in some studies to elevate when using only red-light enforcement. The first objective is the same as for traditional RLCs whilst it could also be expected that the threat of detection for speeding by the cameras may encourage a proportion of motorists to travel at lower speeds through the intersection. As such the cameras appear to be consistent in objective with both the red-light and FSSCs. Geographical reach in effectiveness and likely deterrence mechanism is likely to be similar to both single function camera types.

It was considered likely that the effects of the combined RLSCs will be highly localised to the intersection and perhaps the leg on which the camera is installed. Possible halo effects on other intersection legs and up and down each intersecting road for some distance are also possible. Spread of the halo might be related to the use of accompanying signage. TMR advised that the fixed digital RLSCs are signed where it is safe and practical to do so. Thus, CDOP crash effects are expected to be localised to the site with deterrence driven primarily by the camera presence and also by the issuing of infringement notices.

### Point-to-point (PtP) cameras

Point-to-point camera technology uses a number of cameras mounted at staged intervals along a particular route. The cameras are able to measure the average speed between two points and/or the spot speed at an individual camera site.

Compared with traditional spot-speed fixed cameras, which have a site-specific effect, the PtP camera system has a link-long influence on drivers and their speeds, despite enforcement being visible only at the start and end of the enforced road length. It is likely that the CDOP PtP cameras provide deterrence along the full length of road between the PtP start and end gantries.

Point-to-point camera systems are signed in Queensland: with one prominent sign installed in the direction of enforcement within approximately one kilometre of the first camera in the PtP system and a second prominent sign installed in the direction of enforcement within approximately one kilometre of reaching the last camera in the PtP system. The presence of signage will most likely localise the effects of the PtP system to within the signed area with possible halo effects downstream of the covered link.

### Road Safety Camera Trailers

Highly visible road safety camera trailers are deployed to high risk areas including highways and motorways, roadworks sites and school zones. Once the camera trailer is deployed and set up, its operation is managed and monitored remotely with daily checks.

Road safety camera trailer sites are selected using strict criteria, including an assessment of speed related crash history or potential crash risk.

### Mobile speed cameras

The mobile speed camera program in Queensland first commenced in May 1997. The use of mobile speed cameras in Queensland can generally be described as overt or covert with overt cameras operating from marked vehicles, tripod mounts, trailers and hand-held devices; and signs advising motorists that they have passed a speed camera posted within ten meters of the camera; and covert deployments operating from a variety of unmarked vehicles. Whilst some operations using hand held devices are considered covert it is likely that they are not fully covert. Covert mobile speed cameras operate in both urban and rural areas.

The operation of cameras at particular locations is determined using a randomised scheduling procedure with some scope for variation. Locations for the deployment of cameras meet strict criteria, with crash history being the primary criterion used to identify sites. Other factors which contribute to the selection process include areas of high-risk speeding behaviour that have been checked and referred to the relevant committee, including consideration of Workplace Health and Safety issues for workers at locations where roadwork is in progress.

The general effect might in fact be an aggregate of localised effects in space over a wide number of locations that target the Queensland crash population. There is a strong spatial correlation with the mobile camera zones of operation with the bulk of crash effects being measured in areas within two kilometres of the operational camera zone centroids.

Another key development in the Queensland CDOP is the introduction of covert mobile camera operations in 2010. Based on the combined covert and overt operation of the Queensland mobile speed camera program, a range of likely mechanisms and distributions of effects might be expected. They include effects generalised and localised in space related to the mode of operation as well as effects generalised and localised in time related to both the presence of a camera and/or the receipt of an infringement notice.

## Fixed Speed camera locations and operational data

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 44 Fixed Speed Camera location and operational data | | | | **Location ID** | | **Speed Camera Go-Live Date** | | **Decommissioned Date** | **Before Period (years)** | **RLC to RLSC period** | **After Period (years)** | |
| ***Fixed Spot Speed Cameras*** | | | |  |  | |  | |  |  |  |
| Began as Analogue, now Digital | Bruce Hwy, Burpengary | | | 3001 | 14/12/2007 | |  | | 16.0 |  | 14 |
| Main Street, Kangaroo Point | | | 3002 | 14/12/2007 | |  | | 16.0 |  | 14 |
| Pacific Mwy, Tarragindi | | | 3003 | 22/02/2008 | |  | | 16.1 |  | 12.8 |
| Gold Coast Hwy, Broadbeach | | | 3004 | 31/08/2010 | |  | | 18.7 |  | 10.3 |
| Gold Coast Hwy, Southport | | | 3005 | 29/09/2009 | |  | | 17.7 |  | 11.3 |
| Toowoomba Connection Road, Redwood | | | 3006 | 31/08/2009 | | 12/12/2013 | |  |  |  |
| Warrego Hwy, Muirlea | | | 3007 | 24/12/2009 | |  | | 18.0 |  | 12 |
| Nicklin Way, Warana | | | 3008 | 30/06/2010 | |  | | 18.5 |  | 10.5 |
| Sunshine Mwy, Mooloolaba | | | 3009 | 24/02/2010 | |  | | 18.2 |  | 10.9 |
|  | Gateway Motorway, Nudgee | | | 1001 | 02/08/2011 | | 08/04/2016 | |  |  |  |
| Digital | Pacific Mwy, Loganholme | | | 1002 | 2/08/2011 | |  | | 19.6 |  | 9.3 |
|  | Nambour Connection Road (Northbound), Woombye | | | 1011 | 10/01/2013 | |  | | 21.0 |  | 8.0 |
|  | Pacific Mwy, Gaven | | | 1012 | 28/03/2013 | |  | | 21.2 |  | 7.8 |
| Clem 7 tunnel | | 1003-1006 | | | 6/04/2010 | |  | | 18.3 |  | 10.7 |
| Airport-Link tunnel | | 1007-1010 | | | 25/07/2012 | |  | | 20.6 |  | 8.4 |
| Legacy Way Tunnel | | 1013-1016 | | | 25/06/2015 | |  | | 23.5 |  | 5.5 |
| ***Point-to-Point*** (fixed spot and average speed cameras)  Bruce Hwy b/n Landsborough and the Glass House Mountains | | | 580011, 580012 | | 2/08/2011 | |  | | 19.6 |  | 9.3 |
| Bruce Hwy b/n Landsborough and Elimbah | | | 4002 | | 21/07/2017 | |  | | 25.6 |  | 3.4 |
| Mt Lindesay Hwy, Maclean | | | 403 | | 21/07/2017 | | 03/2019 | |  |  |  |
| Toowoomba Second Range Crossing, Athol to Wellcamp (100 kph) & | | |  | |  | |  | |  |  |  |
| Toowoomba Second Range Crossing, Charlton to Cranley (100 kph) | | | 5001 | | 01/10/2021 | |  | | 29.7 |  | 0.25 |
| Toowoomba Second Range Crossing, Harlaxton to Postman’s   Ridge/Withcott (90 speed limit) | | | 5002 | | 01/10/2021 | |  | | 29.7 |  | 0.25 |
|  | | |  | |  | |  | |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 45 Fixed Speed Camera location and operational data…continued | | **Location ID** | | **RLC Go-Live Date** | | **Speed Camera Go-Live Date** | **Before Period (years)** | **RLC to RLSC period** | **After Period (years)** | | |
| ***Red-light speed cameras at new locations*** | |  |  | |  | |  |  |  | |
|  | Beaudesert Rd, Calamvale (at i/s with Compton Rd) | 2002 |  | | 2/08/2011 | | 19.6 |  | 10.4 | |
|  | Kingston Rd, Waterford West (at i/s with Muchow Rd) | 2015 |  | | 21/07/2017 | | 25.6 |  | 4.4 |
|  | Logan Road, Upper Mount Gravatt (at i/s with Newnham Rd) | 2016 |  | | 24/01/2017 | | 25.1 |  | 4.9 |
|  | Morayfield Road, Morayfield (at i/s with Devereaux Drive) | 2017 |  | | 24/01/2017 | | 25.1 |  | 4.9 |
|  | Riverway Drive & Douglas Arterial Road on Ramp | 2018 |  | | 22/12/2017 | | 26.0 |  | 4.0 |
|  | Sheridan Street & Upward Street | 2019 |  | | 24/09/2018 | | 26.7 |  | 3.3 |
|  | Moores Creek Road & High Street | 2020 |  | | 15/07/2019 | | 27.5 |  | 2.5 |
|  | Clontarf-Anzac Avenue Road & Boardman Road | 2021 |  | | 08/01/2019 | | 27.0 |  | 3.0 |
|  | Cunningham Highway & Fitzroy Street | 2022 |  | | 24/09/2018 | | 26.7 |  | 3.3 |
|  | Glenlyon Street & Tank Street | 2023 |  | | 08/01/2019 | | 27.0 |  | 3.0 |
|  | Warwick Rd & Cunningham Hwy Ramp | 2024 |  | | 24/09/2018 | | 26.7 |  | 3.3 |
|  | Old Logan Road & Alice Street | 2026 |  | | 24/09/2018 | | 26.7 |  | 3.3 |
|  | Redland Sub Arterial Road & Gateway Motorway | 2027 |  | | 24/09/2018 | | 26.7 |  | 3.3 |
|  | Brisbane Beenleigh Rd & Castile Crescent | 2108 |  | | 24/09/2018 | | 26.7 |  | 3.3 |
|  | Bruce Highway & Coombs Street | 2109 |  | | 24/09/2018 | | 26.7 |  | 3.3 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | |  | |  |  |  |
| Table 46 Fixed Speed Camera location and operational data…continued | | **Location ID** | | **RLC Go-Live Date** | | **Speed Camera Go-Live Date** | **Before Period (years)** | **RLC to RLSC period** | **After Period (years)** | | |
| ***Red-light speed cameras at red light camera locations*** | |  |  | |  | |  |  |  | |
|  | Waterworks Rd, Ashgrove (at i/s with Jubilee Tce) | 2001 | 12/02/2002 | | 2/08/2011 | | 10.1 | 9.5 | 10.4 | |
|  | Markeri St, Clear Island Waters (Bermuda St) - Gold Coast | 2003 | 11/04/2001 | | 1/07/2013 | | 9.3 | 12.2 | 8.5 | |
|  | Nathan St, Aitkenvale (at i/s with Bergin Rd) - Townsville | 2004 | 26/06/2000 | | 8/07/2013 | | 8.5 | 13.0 | 8.5 | |
|  | Musgrave St, Berserker (at i/s with High St) - Rockhampton | 2005 | 10/11/1992 | | 31/07/2013 | | 0.9 | 20.7 | 8.4 | |
|  | Mulgrave Rd, Mooroobool (at i/s with McCoombe St) - Cairns | 2006 | 10/08/1992 | | 11/07/2013 | | 0.6 | 20.9 | 8.5 | |
|  | Bruce Hwy, Mount Pleasant (at i/s with Sams Rd) – Mackay (decommissioned 18/3/2020) | 2007 | 01/11/1992 | | 15/07/2013 | | 0.8 | 20.7 | 6.7 | |
|  | James Street, South Toowoomba (at i/s with Neil Street) | 2010 | 10/01/1992 | | 25/07/2016 | | 0 | 24.6 | 5.4 | | |
|  | James Street, South Toowoomba (at i/s with Pechey Street) | 2011 | 10/01/1992 | | 25/07/2016 | | 0 | 24.6 | 5.4 |
|  | James Street, Rangeville (at i/s with MacKenzie Street) | 2012 | 05/09/1997 | | 25/07/2016 | | 5.7 | 18.9 | 5.4 |
|  | Bridge Street, Wilsonton (at i/s with McDougall Street) | 2014(2 RLS) | 01/06/2000 | | 25/07/2016 | | 8.4 | 16.2 | 5.4 |
|  | Old Cleveland Road & Cavendish Road | 2025 | 10/12/1992 | | 08.01.2019 | | 0.9 | 26.1 | 3.0 |
|  | Gympie Road & Robinson Road West | 2029 | 10/07/1991 | | 15/02.2019 | | 0 | 27.6 | 2.9 |
|  | Southport-Nerang Road & Currumburra Road | 2100 | 27/05/1998 | | 13/04.2018 | | 6.4 | 19.9 | 3.7 |
|  | Smith Street & Kumbari Avenue | 2101/2028 | 15/03/2000 | | 08/01.2019 | | 8.2 | 18.8 | 3.0 |
|  | Bermuda Street & Christine Avenue | 2102 | 01/09/2001 | | 08/01.2019 | | 9.7 | 17.4 | 3.0 |
|  | Bruce Highway & Monkland Street | 2103 | 10/11/1992 | | 24/09.2018 | | .9 | 25.9 | 3.3 |
|  | Lutwyche Road & Kedron Park Road | 2104 | 29/08/2012 | | 08/01.2019 | | 20.7 | 6.4 | 3.0 |
|  | Morayfield Road & Caboolture River Road | 2105 | 10/11/1992 | | 08/01.2019 | | .9 | 26.2 | 3.0 |
|  | Lutwyche Road & Norman Avenue | 2106 | 10/07/1991 | | 08/01.2019 | | 0 | 27.5 | 3.0 |
|  | Bermuda Street & Rudd Street | 2107 | 03/12/1997 | | 13/04.2018 | | 5.9 | 20.4 | 3.7 |

## Control and treatment crash selection

Table 47 Treatment and control Selection Criteria

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | **Treatment Crash coded as:** | | **Control Crash coded as:** |
| Red-light cameras (RLCs) | Signalised Intersection  ≤100m from camera  Not a FSSC, AvSpeed nor RLSC treatment crash  Not at a nearby or underground intersection | | Signalised intersection >100m from camera, not an RLC, RLSC or FSSC treatment crash and  Matched to camera site by:   * Intersection configuration (T, Y or X) * SLA and if needed surrounding SLA * Speed limit * Divided or undivided road * Pre-period Crash History ranging 2.5% to 197.5% of treatment site   Not a RLSC control. Uniquely identified control intersections labelled with more than one SLA, speed limit or dividedness were only assigned to one control group. Not decommissioned prior to 2020 without upgrade. | | |
| Red-light speed cameras (RLSCs) | Signalised Intersection  ≤100m from camera  Not a FSSC, Av Speed nor RLC treatment crash  Not at a nearby or underground intersection | | Signalised intersection >100m from camera, not an RLC, RLSC or FSSC treatment crash and  Matched to camera site by:   * Intersection configuration (T, Y or X) * SLA and if needed surrounding SLA * Speed limit * Divided or undivided road * Pre-period Crash History ranging 2.5% to 197.5% of treatment site   Not an RLC control. Uniquely identified control intersections labelled with more than one SLA, speed limit or dividedness were only assigned to one control group. | | |
| Fixed Spot Speed Cameras (FSSCs) (except those at PtP site and tunnel sites) | On same road and not a ramp  ≤1000m from camera  Not an RLC, AV Speed or RLSC treatment crash | | On same road and not a ramp  >1000m from camera  Not an RLC, RLSC or FSS treatment crash  And  Matched to camera site by:   * SLA or <2km from camera * On same road * Speed limit, but widened if 70, 90 or 110   RLC and RLSC control crashes may be on the same length of road as the potential FSSC control crash pool. These could not be FSSC control crashes. Not decommissioned prior to 2020. | | |
| Clem 7 and Airport-Link tunnels | Not a ramp,  Not an RLC, RLSC or FSS treatment crash  On Southern Cross Way or on Port of Brisbane Motorway | | |
| Average Speed cameras and FSSCs at the same site | On same road and not a ramp  Between average speed cameras and 5km along road North and South of them.  Not a FSSC, RLC or RLSC treatment crash. | | On same road and not a ramp  >100m from camera  Not an RLC, RLSC or FSS treatment crash  And  Matched to camera site by:   * On same road * A further 7.2km North/South of treatment section for 4001/2 and a further 5km for 403 and a further 10 km for 5001 & 5002 | | |
| Mobile Trailer Cameras | On same road and not a ramp  ≤1000m from camera Brisbane, Logan Moreton, and Gold Coast.  ≤4000m from camera other.  Not an RLC, FSSC, AV Speed or RLSC treatment crash | | On same road and not a ramp for target and roadwork ops.  In same SLA and 40 km/hr speed zone for School ops.  P2P controls shared for Bruce Hwy 587904  1000m to 4000m from camera for Brisbane, Logan Moreton, and Gold Coast. (Use to 2 km for ops with high crash numbers.)  4000m to 10000m for other cameras. (Use to 8 km for ops with high crash numbers.)  Not a fixed camera treatment or control crash. | | |
| Mobile Speed Cameras | Sector in which a mobile speed camera operation has taken place since the commencement of the program  Not a RLC, FSS, Av Speed or RLSC treatment site | | Not a MSC, RLC, RLSC, Av Speed or FSS treatment site and sector where mobile speed cameras have never been operated.  And matched by police region and urban rural status of sector as defined by TMR protocol. | | |

## Prior Crash History at fixed camera evaluation treatment and control sites

### Red-light cameras (RLCs)

Table 48 Number of casualty crashes (any severity) at treatment and control intersections prior to red-light camera installation used in analysis

|  |  |  |
| --- | --- | --- |
| **ID** | *Treat-ment* | *Control* |
| **20** | 6 | 23 |
| **25 &36** | 34 | 14 |
| **34&38** | 52 | 181 |
| **35&54(&37)** | 16 | 182 |
| **39** | 9 | 71 |
| **40 & 60** | 9 | 43 |
| **41 (&14)** | 16 | 139 |
| **42** | 31 | 58 |
| **43, 44 and 52** | 53 | 452 |
| **45** | 11 | 141 |
| **46** | 20 | 79 |
| **47** | 39 | 52 |
| **48** | 16 | 67 |
| **49** | 7 | 104 |
| **50** | 5 | 25 |
| **53 (2001)** | 25 | 167 |
| **56** | 15 | 79 |
| **57** | 30 | 148 |
| **58** | 35 | 89 |
| **59** | 30 | 82 |
| **61** | 52 | 589 |
| **62,63,64&65** | 118 | 197 |
| **67 & 68 (2104)** | 66 | 211 |
| **69 & 500** | 63 | 277 |
| **75** | 18 | 119 |
| **84** | 9 | 18 |
| **94** | 25 | 177 |
| **110, 118 & 119 (2101)** | 45 | 211 |

|  |  |  |  |
| --- | --- | --- | --- |
| **ID** | *Treatment* | | *Control* |
| **113 (2107)** | 20 | | 68 |
| **114 (2100)** | 22 | | 50 |
| **115,117&**  **125** | 51 | | 35 |
| **116** | 9 | | 32 |
| **118** | 11 | | 27 |
| **121** | 13 | | 125 |
| **122** | 9 | | 120 |
| **123 (2102)** | 17 | | 94 |
| **124 (2003)** | 17 | | 77 |
| **126** | 13 | | 28 |
| **155 (2012) (&151)** | 10 | | 11 |
| **157/158 (2014)** | 14 | | 11 |
| **156 (2013)** | 12 | | 79 |
| **206 & 209** | 22 | | 242 |
| **207** | 19 | | 39 |
| **208 (2004)** | 11 | | 32 |
| **210** | 13 | | 99 |
| **255** | 7 | | 29 |
| **355** | 37 | | 155 |
| **407** | 18 | | 53 |
| **408 &411** | 22 | | 58 |
| **409** | 5 | | 149 |
| **451,452,453&454** | 45 | | 126 |
| **460 and 462** | 16 | | 64 |
| **461 & 463** | 40 | | 103 |
|  | |  |  |

### Fixed spot (FSSCs), point-to-point (PtP) and red-light speed cameras (RLSCs)

Table 49 Number of casualty crashes (any severity) at treatment and control intersections prior to red-light speed camera installation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ID** | *treatment* | | *control* | |
| 2001 (from 53) | | 33 | | 153 | |
| 2002 | | 99 | | 184 | |
| 2003 (from 124) | | 91 | | 212 | |
| 2004 (from 208) | | 27 | | 72 | |
| 2005 (from 252) | | 34 | | 390 | |
| 2006 (from 304) | | 100 | | 432 | |
| 2007 (from 353) | | 78 | | 51 | |
| 2010/2011 (from 153/154) | | 103 | | 104 | |
| 2012 (from 155) | | 9 | | 35 | |
| 2014 (from 157/158) | | 20 | | 16 | |
| 2015 | | 52 | | 155 | |
| 2016 | | 42 | | 358 | |
| 2017/2105 (from 83) | | 107 | | 139 | |
| 2018 | | 32 | | 41 | |
| 2019 | | 53 | | 612 | |
| 2020 | | 52 | | 183 | |
| 2021 | | 96 | | 216 | |
| 2022 | | 19 | | 60 | |
| 2023 | | 44 | | 120 | |
| 2024 | | 18 | | 58 | |
| 2025 (from 19) | | 114 | | 390 | |
| 2026 | | 43 | | 85 | |
| 2027 | | 102 | | 174 | |
| 2029 (from 14) | | 149 | | 494 | |
| 2100 (from 114) | | 90 | | 213 | |
| 2101 (from 110/119) | | 88 | | 701 | |
| 2102 (from 123) | | 77 | | 265 | |
| 2103 (from 410) | | 50 | | 47 | |
| 2104 (from 510) | | 32 | | 76 | |
| 2106 (from 13) | | 56 | | 151 | |
| 2107 (from 113) | | 48 | | 326 | |
| 2108 | | 42 | | 115 | |
| 2109 | | 30 | | 235 | |
|  | |  | |  | |

Table 50 Frequency of treatment and control crashes (by severity) prior to fixed spot speed camera installation

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Casualty Crash** | | | | | **Serious Injury Crash** | | | | | **Minor Injury Crash** | | | |
| **ID** | | *treatment* | | | *control* | | *treatment* | | *control* | | | *treatment* | | | *control* |
| Fixed speed |  | | |  | | | |  | | |  | | |  | | |
| 3001 | | 46 | | | 150 | | 13 | | 48 | | | 33 | | | 102 |
| 3002 | | 289 | | | 348 | | 73 | | 102 | | | 216 | | | 246 |
| 3003 | | 173 | | | 163 | | 40 | | 55 | | | 133 | | | 108 |
| 3004 | | 273 | | | 714 | | 84 | | 238 | | | 189 | | | 476 |
| 3005 | | 328 | | | 279 | | 90 | | 86 | | | 238 | | | 193 |
| 3007 | | 43 | | | 25 | | 18 | | 11 | | | 25 | | | 14 |
| 3008 | | 175 | | | 160 | | 48 | | 49 | | | 127 | | | 111 |
| 3009 | | 101 | | | 51 | | 33 | | 26 | | | 68 | | | 25 |
|  | |  | | |  | |  | |  | | | 76 | | |  |
| 1002 | | 145 | | | 286 | | 57 | | 101 | | | 88 | | | 185 |
| 1011 | | 69 | | | 54 | | 35 | | 16 | | | 34 | | | 38 |
| 1012 | | 121 | | | 201 | | 45 | | 89 | | | 76 | | | 112 |
| Point-to-Point | | |  | | |  | | | |  | | |  | | | |
| Bruce Highway | | 824 | | | 252 | | 351 | | 106 | | | 473 | | | 146 |
| Toowoomba Bypass | | 8 | | | 143 | | 6 | | 78 | | | 2 | | | 65 |

### Trailer cameras

Table 51 Number of casualty crashes (any severity) at treatment and control intersections not during roadworks and school trailer camera operations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Type** | **ID** | | *treatment* | | | *control* |
| Roadworks | | 185: 903,906,907,910 &911 | | 165 | 110 | |
| Roadworks | | 185: 904, 909 & 912 | | 84 | 157 | |
| Roadworks | | 185905 | | 181 | 169 | |
| Roadworks | | 385906 | | 236 | 170 | |
| Roadworks | | 385908 | | 157 | 276 | |
| Roadworks | | 385916 | | 81 | 84 | |
| Roadworks | | 385: 919&920 | | 614 | 463 | |
| Roadworks | | 385: 921&922 | | 458 | 164 | |
| School | | 186901 | | 11 | 262 | |
| School | | 286901 | | 14 | 78 | |
| School | | 286902 | | 7 | 125 | |
| School | | 286903 | | 17 | 44 | |
| School | | 286904 | | 15 | 70 | |
| School | | 386: 901& 902 | | 26 | 432 | |
| School | | 386903 | | 19 | 11 | |
| School | | 386904 | | 26 | 72 | |
| School | | 386905 | | 30 | 55 | |
| School | | 386906 | | 4 | 63 | |
| School | | 386907 | | 80 | 258 | |
| School | | 386908 | | 32 | 13 | |
| School | | 386909 | | 122 | 334 | |
| School | | 486901 | | 165 | 181 | |
| School | | 486902 | | 8 | 116 | |
| School | | 486903 | | 24 | 33 | |
| School | | 486904 | | 123 | 116 | |
| School | | 486905 | | 17 | 35 | |
| School | | 486906 & 486907 | | 28 | 827 | |
| School | | 486908 | | 10 | 22 | |
| School | | 586901 | | 18 | 170 | |
| School | | 586902 | | 46 | 217 | |
| School | | 586903 | | 15 | 11 | |
| School | | 586904 | | 29 | 93 | |

Table 52 Number of casualty crashes (any severity) at treatment and control intersections *not during* targeted trailer camera operations

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Type** | **ID** | | *treatment* | | | | *control* |
| Targeted | | Warrego Hwy | | 527 | | 1466 | |
| Targeted | | 187901 | | 574 | | 56 | |
| Targeted | | 187902 | | 600 | | 78 | |
| Targeted | | 187903 | | 108 | | 97 | |
| Targeted | | 187904 &187911 | | 231 | | 343 | |
| Targeted | | 187905 | | 70 | | 88 | |
| Targeted | | 187906 | | 57 | | 59 | |
| Targeted | | 187910 | | 20 | | 43 | |
| Targeted | | 287901 | | 95 | | 76 | |
| Targeted | | 287902 | | 106 | | 111 | |
| Targeted | | 287903 | | 303 | | 70 | |
| Targeted | | 287904 | | 185 | | 56 | |
| Targeted | | 287905 | | 363 | | 178 | |
| Targeted | | 287906 | | 179 | | 45 | |
| Targeted | | 287907 & 287908 | | 374 | | 132 | |
| Targeted | | 287: 909 & 910 | | 88 | | 133 | |
| Targeted | | 287911 | | 31 | | 85 | |
| Targeted | | 287912 | | 502 | | 350 | |
| Targeted | | 287913 | | 161 | | 287 | |
| Targeted | | 387: 901,908,909,917 | | 471 | | 173 | |
| Targeted | | 387902 | | 413 | | 131 | |
| Targeted | | 387903 | | 334 | | 203 | |
| Targeted | | 387904 & 387924 | | 60 | | 70 | |
| Targeted | | 387905 | | 247 | | 182 | |
| Targeted | | 387906 | | 175 | | 231 | |
| Targeted | | 387907, 387918 & 387927 | | 83 | | 91 | |
| Targeted | | 387916 | | 648 | | 528 | |
| Targeted | | 387: 919&920 | | 301 | | 123 | |
| Targeted | | 387923 | | 527 | | 1466 | |
| Targeted | | 487902 | | | 348 | 202 | |
| Targeted | | 487903 | | | 397 | 1034 | |
| Targeted | | 487905 | | | 114 | 211 | |
| Targeted | | 487910 | | | 25 | 96 | |
| Targeted | | 487911 | | | 362 | 74 | |
| Targeted | | 487914 | | | 101 | 605 | |
| Targeted | | 487915 | | | 39 | 50 | |
| Targeted | | 487916 | | | 154 | 65 | |
| Targeted | | 487917 | | | 39 | 41 | |
| Targeted | | 587904 | | | 104 | 101 | |
| Targeted | | Pacific Hwy, Oxenford | | | 351 | 671 | |
| Targeted | | Sunshine Motorway | | | 281 | 789 | |
| Targeted | | Bruce Highway, Sunshine Coast | | | 111 | 642 | |

## Full list of current RLC sites ranked for RLSC upgrade

Table 53 Full ranked priority list of RLC sites for RLCS upgrade

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **RLC SITE** | **Intersection Name** | **KSI Crash Reduction** | **Minor Injury Crash Reduction** | **Community Cost Reduction** |
| 92 | East St & Limestone St | 4.771 | 0 | $771,849.04 |
| 42 | Beams Rd & Gympie Arterial Rd (1/04) | 4.037 | 2.158 | $701,099.60 |
| 506 | Gateway Art Rd Ramp & Old Cleveland Rd | 4.037 | 1.45 | $685,352.81 |
| 15 | Duke St/Prince St & Juliette St | 3.303 | 0 | $534,357.03 |
| 16 | Ipswich Rd & Venner Rd/Waterton St | 3.303 | 0 | $534,357.03 |
| 9 | Compton Rd & Gowan Rd | 2.569 | 3.626 | $496,257.70 |
| 121 | Cottesloe Dr & Southport - Burleigh Rd | 1.835 | 3.652 | $378,089.97 |
| 206 | Kings Rd & Woolcock St/Townsville Port Rd | 2.202 | 0 | $356,238.02 |
| 301 | Cairns Western Arterial Rd (Pease St) & Hoare St/Moody St | 2.202 | 0 | $356,238.02 |
| 511 | Main St & Vulture St | 1.835 | 1.882 | $338,723.00 |
| 103 | Ashmore Rd & Southport - Nerang Rd | 1.835 | 1.528 | $330,849.61 |
| 461 | Bourbong St/Mulgrave St/Bundaberg - Bargara Rd & Isis Hwy | 1.835 | 0.643 | $311,166.12 |
| 507 | Albion Rd & Lutwyche Rd | 1.835 | 0.466 | $307,229.43 |
| 8 | Kessels Rd (Not Griffith Art. Rd) & Orange Grove Rd | 1.835 | 0.289 | $303,292.73 |
| 106 | Gold Coast Hwy & Labrador - Carrara Rd | 1.468 | 2.957 | $303,259.31 |
| 104 | Gold Coast Hwy & Southport - Nerang Rd | 1.835 | 0.112 | $299,356.03 |
| 12 | Boundary St & Leichhardt St/St Paul's Tce | 1.835 | 0.112 | $299,356.03 |
| 36 | Dawson Rd & Klumpp Rd & Logan Sub-Arterial Rd (U90) | 1.835 | 0 | $296,865.02 |
| 451 | Ferry St & Maryborough - Cooloola Rd (Alice St) | 1.835 | 0 | $296,865.02 |
| 152 | Bridge St & Holberton St | 1.835 | 0 | $296,865.02 |
| 1 | Gympie Arterial Rd (1/04) & Rode Rd | 1.468 | 2.426 | $291,449.22 |
| 37 | Leopard St & Stanley St | 1.468 | 1.718 | $275,702.44 |
| 411 | Nicklin Wy & Jessica Blvd/Kensington Dr | 1.468 | 1.541 | $271,765.74 |
| 82 | Anzac Ave & Victoria Ave | 1.468 | 0.656 | $252,082.26 |
| 45 | Lutwyche Rd & Northey St | 1.468 | 0.479 | $248,145.56 |
| 24 | Bennetts Rd & Crown St/Macrossan Ave | 1.468 | 0.302 | $244,208.86 |
| 203 | North Townsville Rd & (Boundary St & Woolcock St & Charters Towers Rd) | 1.468 | 0.302 | $244,208.86 |
| 204 | Anne St & Ross River Rd | 1.468 | 0.302 | $244,208.86 |
| 463 | Heidke St/Johanna Blvd & Takalvan St/Isis Hwy | 1.468 | 0.125 | $240,272.17 |
| 253 | Fitzroy St & George St | 1.468 | 0 | $237,492.01 |
| 254 | Bolsover St & Fitzroy St | 1.468 | 0 | $237,492.01 |
| 452 | Pallas St & Walker St | 1.468 | 0 | $237,492.01 |
| 151 | James St & Kitchener St | 1.468 | 0 | $237,492.01 |
| 94 | Chermside Rd & Brisbane Rd & Glebe Rd | 1.468 | 0 | $237,492.01 |
| 509 | Griffith Arterial Rd (U20 -1/95) & Mains Rd | 1.101 | 2.439 | $232,365.36 |
| 126 | Discovery Dr/Town Centre Dr & Gold Coast Hwy | 1.101 | 1.908 | $220,555.27 |
| 18 | Cornwall St & Ipswich Rd | 1.101 | 1.554 | $212,681.87 |
| 405 | Mooloolaba Rd & Sugar Rd | 1.101 | 1.377 | $208,745.18 |
| 116 | Labrador - Carrara Rd & Napper Rd | 1.101 | 1.2 | $204,808.48 |
| 84 | Nathan Rd/Chelsea St & Redcliffe Rd | 1.101 | 1.2 | $204,808.48 |
| 49 | Creek Rd & Meadowlands Rd | 1.101 | 0.846 | $196,935.09 |
| 205 | South Townsville Road & Putt St/Queens Rd | 1.101 | 0.669 | $192,998.39 |
| 109 | North St & Scarborough St | 1.101 | 0.669 | $192,998.39 |
| 302 | James St & Sheridan St | 1.101 | 0.669 | $192,998.39 |
| 48 | Cosmic St/Leadenhall St & Mains Rd | 1.101 | 0.669 | $192,998.39 |
| 58 | Gympie Arterial Rd (1/04) & Zillmere Rd | 1.101 | 0.492 | $189,061.69 |
| 17 | Ann St & East St/James St | 1.101 | 0.492 | $189,061.69 |
| 11 | Cordelia St & Melbourne St | 1.101 | 0.315 | $185,125.00 |
| 56 | Canna St & McCullough St | 1.101 | 0.138 | $181,188.30 |
| 108 | Coolangatta Rd & Musgrave St | 1.101 | 0.138 | $181,188.30 |
| 503 | Takalvan St & Walker St | 1.101 | 0 | $178,119.01 |
| 47 | Kessels Rd/Griffith Arterial Rd & Macgregor St | 0.367 | 4.766 | $165,374.68 |
| 34 | Junction Rd & Sandgate Rd/East - West Arterial Rd | 0.734 | 1.39 | $149,661.31 |
| 35 | Leopard St & Vulture St | 0.734 | 1.39 | $149,661.31 |
| 59 | Bald Hills Rd & Strathpine Sub-Arterial Rd (1/04) | 0.734 | 1.213 | $145,724.61 |
| 29 | Turbot St & Wharf St | 0.734 | 1.213 | $145,724.61 |
| 61 | Birkdale Rd/Moreton Bay Rd & Capalaba - Cleveland Rd | 0.734 | 0.859 | $137,851.22 |
| 407 | Beerburrum St & Nicklin Wy | 0.734 | 0.505 | $129,977.82 |
| 156 | Hursley Rd & Tor St/Warrego Hwy | 0.734 | 0.505 | $129,977.82 |
| 23 | Holland Rd/Marshall Rd & Logan Rd | 0.734 | 0.328 | $126,041.13 |
| 409 | Maroochydore - Mooloolaba Rd & Okinja Rd | 0.734 | 0.328 | $126,041.13 |
| 118 | Firestone St/Queen St & Wardoo St | 0.734 | 0.328 | $126,041.13 |
| 32 | Cliveden Ave & Oxley Rd | 0.734 | 0.151 | $122,104.43 |
| 73 | Browns Plains Rd & Third Ave/Trulson Dr | 0.734 | 0.151 | $122,104.43 |
| 31 | Broadwater Rd & Logan Rd (1/95) | 0.734 | 0 | $118,746.01 |
| 453 | Saltwater Creek Rd/Maryborough - Hervey Bay Rd & Woodstock St | 0.734 | 0 | $118,746.01 |
| 454 | Alice St & Lennox St | 0.734 | 0 | $118,746.01 |
| 504 | Ann St & George St | 0.367 | 1.58 | $94,514.14 |
| 57 | Rochedale Rd & Underwood Rd | 0.367 | 1.403 | $90,577.44 |
| 21 | Brookes St & St Pauls Tce | 0.367 | 1.049 | $82,704.05 |
| 115 | Gold Coast Hwy & Government Rd/Hollywell Rd | 0.367 | 0.872 | $78,767.35 |
| 44 | Ann St & North Quay | 0.367 | 0.695 | $74,830.65 |
| 25 | Broadwater Rd & Newnham Rd | 0.367 | 0.518 | $70,893.96 |
| 50 | Toohey Rd & Weller Rd | 0.367 | 0.518 | $70,893.96 |
| 22 | Musgrave Rd & Windsor Rd | 0.367 | 0.518 | $70,893.96 |
| 91 | Moffatt St & Ipswich - Cunningham Hwy Connection Rd | 0.367 | 0.518 | $70,893.96 |
| 38 | Bayview Tce/Wagner Rd & Sandgate Rd | 0.367 | 0.518 | $70,893.96 |
| 39 | Grange Rd & Raymont Rd | 0.367 | 0.518 | $70,893.96 |
| 28 | Northcliffe St & Wynnum Rd | 0.367 | 0.518 | $70,893.96 |
| 75 | Ferguson St/Gunn St & Logan Rd/Pacific Hwy Connection Rd | 0.367 | 0.341 | $66,957.26 |
| 117 | Central St & Government Rd | 0.367 | 0.341 | $66,957.26 |
| 408 | Nicklin Wy & Wyanda Dr/Main Dr | 0.367 | 0.341 | $66,957.26 |
| 26 | Coonan St & Westminster Rd | 0.367 | 0.341 | $66,957.26 |
| 10 | Margaret St & William St | 0.367 | 0.341 | $66,957.26 |
| 74 | Ewing Rd & Smith Rd | 0.367 | 0.164 | $63,020.56 |
| 27 | Ellison Rd & Newman Rd | 0.367 | 0.164 | $63,020.56 |
| 105 | Gold Coast Hwy & Tugun - Currumbin Rd (1/10) | 0.367 | 0 | $59,373.00 |
| 508 | Dawson St & Junction Rd/Rose St | 0.367 | 0 | $59,373.00 |
| 354 | Gordon St/Milton St & Mackay - Slade Point Rd | 0.367 | 0 | $59,373.00 |
| 93 | Blackstone Rd & South Station Rd | 0.367 | 0 | $59,373.00 |
| 46 | Moree St/Wilgarning St& Webster Rd | 0.367 | 0 | $59,373.00 |
| 401 | Maroochydore - Mooloolaba Rd & Maud St | 0 | 1.593 | $35,430.27 |
| 402 | Nambour - Bli Rd & Nambour Connection Rd | 0 | 1.416 | $31,493.57 |
| 30 | Lisburn St & Stanley St East | 0 | 0.708 | $15,746.79 |
| 355 | Nebo Rd & Gordon St/ Bruce Hwy | 0 | 0.531 | $11,810.09 |
| 207 | Ackers St/Bayswater Rd & Charters Towers Rd | 0 | 0.354 | $7,873.39 |
| 210 | Gulliver St & Ross River Rd/O'Reilly St | 0 | 0.177 | $3,936.70 |

## Full list of current RLC sites ranked for RLSC upgrade

Table 54 Full ranked priority list of currently unenforced signalised intersections for RLCS enforcement

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Intersection id** | **Intersection Name** | **KSI Reduction (5 Year)** | **Minor Crash Reduction (5 Year)** | **Annual Cost Reduction** |
| M7061 | Dances Rd & Pumicestone Rd | 4.4000 | 2.2000 | $760,759.62 |
| M5205 | City Rd & Logan St | 3.9600 | 3.5200 | $718,935.14 |
| M5028 | Nerang - Broadbeach Rd & Southport - Burleigh Rd | 3.3800 | 5.4600 | $668,251.12 |
| M5365 | Hope Island Rd/Tambourine Oxenford Rd Deviation (Tamborine - Oxenford Rd) & Old Pacific Hwy/Heathwood Dr | 3.1200 | 6.2400 | $643,536.66 |
|  | Larsen Rd & Redlynch Connector Rd | 3.9600 | 0.0000 | $640,646.03 |
| M6037 | Taylor St & Tor St (Toowoomba - Cecil Plains Rd & Warrego Hwy) | 3.5200 | 3.0800 | $637,966.11 |
| C5133 | Clifford St/Paradise Island & Gold Coast Hwy/Remembrance Dr | 3.5200 | 1.5600 | $604,159.45 |
| L2517 | Chambers Flat Rd & Waratah Dr | 3.5200 | 1.0400 | $592,594.01 |
| M5217 | Beaudesert - Beenleigh Rd & Tallagandra Rd | 3.5200 | 1.0400 | $592,594.01 |
| M1396 | Gateway Art Rd Ramp S/U & Wynnum Rd | 3.0800 | 4.1600 | $590,803.74 |
| M2733 | Brisbane Rd & Church St | 3.0800 | 2.6400 | $556,997.08 |
| M5011 | Anne St/Minnie St & Southport - Nerang Rd | 3.0800 | 2.6400 | $556,997.08 |
| M7044 | Beerburrum Rd/Old Gympie Rd & Pumicestone Rd | 3.0800 | 2.6000 | $556,107.43 |
| B0161 | Gipps St/Kennigo St & St Pauls Tce | 3.0800 | 2.2000 | $547,210.94 |
| L5470 | Distillery Rd & Fryar Rd/George St overbridge | 2.6400 | 5.2800 | $544,531.02 |
| C5534 | Christine Ave & Robina Town Centre Dr | 2.6400 | 4.4000 | $524,958.74 |
| M7057 | Bruce Hwy Ramp S & Deception Bay Rd/New Settlement Rd | 2.6400 | 3.9000 | $513,838.13 |
| M1608 | Beaudesert Rd (Use After 1/95) & Griffith Arterial Rd (U20 -1/95) | 1.8200 | 9.3600 | $502,616.19 |
| B0077 | Ann St & Gipps St/Bradfield Hwy/Kemp Pl | 2.6000 | 3.3800 | $495,801.52 |
| M1119 | Gympie Arterial Rd & Webster Rd | 2.6000 | 3.1200 | $490,018.80 |
| B0706 | Compton Rd & Gateway Arterial Rd | 2.6400 | 2.6400 | $485,814.19 |
| M1721 | Progress Rd & Western Arterial Rd (1/04) | 2.6400 | 2.6400 | $485,814.19 |
| B0180 | Appleby Rd/Maundrell Tce & Rode Rd | 2.6400 | 2.6000 | $484,924.54 |
| M7006 | Morayfield Rd (Burpengary - Caboolture Rd) & Elliott St/Esme Ave | 2.6400 | 2.3400 | $479,141.82 |
| M1524 | Cannes St/Pacific Mwy Ramp & Marshall Rd | 2.6400 | 1.7600 | $466,241.91 |
| M1657 | Beaudesert Rd & Algester Rd/Illaweena St | 2.0800 | 5.4600 | $457,938.03 |
| L2409 | Loganlea Rd & Moloney Rd/Short St | 2.6400 | 1.3200 | $456,455.77 |
| M6006 | James St & West St | 2.6400 | 1.3200 | $456,455.77 |
| C5601 | Christine Ave & Scottsdale Dr | 2.2000 | 3.9000 | $442,655.24 |
| M1459 | Griffith Rd/Griffith Arterial Rd (U20 -1/95) & Troughton Rd | 2.0800 | 4.6800 | $440,589.88 |
| M1420 | Logan Rd & Warrigal Rd/Pacific Mwy Ramp | 2.2000 | 3.6400 | $436,872.52 |
| M2428 | Brisbane - Beenleigh Rd & Compton Rd | 2.0800 | 4.4200 | $434,807.16 |
|  | Bruce Hwy Eastern Service Rd (01/09) & Deception Bay Rd | 2.2000 | 2.6400 | $414,631.29 |
| B0158 | Murphy Rd & Robinson Rd | 2.2000 | 2.6000 | $413,741.65 |
| M1611 | Beaudesert Rd & Mortimer Rd | 2.2000 | 2.6000 | $413,741.65 |
| M2434 | Kingston Rd & Wembley Rd (1/95) | 1.8200 | 5.2000 | $410,092.70 |
|  | Boundary Rd & Diamond Jubilee Way | 2.2000 | 2.3400 | $407,958.93 |
| C5360 | Hinkler Dr (7/13) & Pappas Way | 2.2000 | 2.2000 | $404,845.16 |
| M5456 | Franklin Dr/Gold Coast - Springbrook Rd & Somerset Dr | 2.2000 | 2.2000 | $404,845.16 |
| M1460 | Griffith Arterial Rd (U20 -1/95) & Orange Grove Rd | 2.2000 | 2.0800 | $402,176.21 |
| M2168 | Anzac Ave (Redcliffe Rd) & Diamond Jubilee Way/Kinsellas Rd | 2.2000 | 2.0800 | $402,176.21 |
| B0568 | Dawson Rd & Newnham Rd | 1.7600 | 5.2800 | $402,165.24 |
| M5346 | Ferry St & Nerang St | 2.2000 | 1.8200 | $396,393.49 |
| M2160 | Anzac Ave & Duffield Rd | 2.2000 | 1.5600 | $390,610.77 |
| M7056 | Bruce Hwy Ramp N & Deception Bay Rd/New Settlement Rd | 2.2000 | 1.5600 | $390,610.77 |
| C5403 | Birmingham Rd & Nielsens Rd | 2.2000 | 1.3200 | $385,272.88 |
| C5528 | Bayswater Ave/Stapley Dr & Scottsdale Dr | 2.2000 | 1.3200 | $385,272.88 |
| M6075 | South St & West St | 2.2000 | 1.3200 | $385,272.88 |
| B0777 | Blunder Rd & Inala Ave | 2.2000 | 1.3000 | $384,828.05 |
| M2422 | Logan Rd (1/95) & Underwood Rd | 2.2000 | 1.3000 | $384,828.05 |
| M2161 | Gympie Arterial Rd & Strathpine Rd/Hoyland St | 2.0800 | 2.0800 | $382,762.69 |
| M5023 | Ashmore Rd & Southport - Burleigh Rd | 1.8200 | 3.9000 | $381,179.10 |
| M5392 | Lakes Esp/Manapouri St & Nerang - Broadbeach Rd | 1.7600 | 4.1600 | $377,255.06 |
| L2415 | Leda Dr & Mandew St | 2.2000 | 0.8800 | $375,486.74 |
| M5395 | Boowaggan Rd & Gooding Dr (Code To 88267) | 2.2000 | 0.7800 | $373,262.62 |
| B0066 | Gipps St & Wickham St | 1.8200 | 3.3800 | $369,613.67 |
| M5492 | Mudgeeraba Rd & Tallai Rd | 1.7600 | 3.5200 | $363,020.68 |
| M1610 | Beaudesert Rd (Use After 1/95) & Boundary Rd | 1.7600 | 3.3800 | $359,906.91 |
| M2417 | Gateway Motorway Ramp & Logan Rd | 1.7600 | 3.3800 | $359,906.91 |
| M2734 | Collingwood Dr & Cunningham Hwy | 2.0800 | 1.0400 | $359,631.82 |
| M5107 | Captain Cook Dr/Pine Ridge Rd & Gold Coast Hwy | 1.8200 | 2.8600 | $358,048.23 |
|  | Old North Rd & Stanley St | 1.7600 | 3.0800 | $353,234.54 |
| M2410 | Mayes Ave & Wembley Rd | 1.8200 | 2.6000 | $352,265.51 |
| B0040 | Countess St/Saul St/May St & Roma St | 1.5600 | 4.4200 | $350,681.92 |
| B0275 | Ann St/Breakfast Ck Rd/Wickham St & Montpelier Rd/Skyring Tce | 1.7600 | 2.8600 | $348,341.47 |
| B0457 | Ipswich Rd/Main St & Stanley St | 1.7600 | 2.8600 | $348,341.47 |
| L2464 | Bryants Rd & Grandis St/Mandew St | 1.7600 | 2.8600 | $348,341.47 |
| M5545 | Mudgeeraba Rd & Pacific Hwy Ramp | 1.7600 | 2.8600 | $348,341.47 |
| M3203 | Nathan St (Use 92647) & Ross River Rd | 2.0800 | 0.5200 | $348,066.38 |
| B0011 | Adelaide St & Creek St | 1.8200 | 2.3400 | $346,482.79 |
| M7071 | Aerodrome Rd/Beachmere Rd & Bribie Island Rd | 1.8200 | 2.3400 | $346,482.79 |
| L1669 | Browns Plains Rd & Fifth Ave | 1.7600 | 2.6400 | $343,448.40 |
| C5126 | Elkhorn Ave/Thomas Dr & Ferny Ave/Gold Coast Hwy | 1.7600 | 2.6000 | $342,558.75 |
| M2531 | Loganlea Rd & Pacific Hwy Ramp | 1.7600 | 2.6000 | $342,558.75 |
| B0041 | Caxton St & Hale St | 1.8200 | 2.0800 | $340,700.07 |
| M1625 | Beaudesert Rd & Algester Rd/Jackson Rd | 1.5600 | 3.9000 | $339,116.49 |
| M1629 | Beaudesert Rd & Honeysuckle Way/Nottingham Rd | 1.5600 | 3.9000 | $339,116.49 |
| M3216 | Hugh St & Woolcock St (North Townsville Rd & North Ward Rd) | 1.7600 | 2.3400 | $336,776.03 |
| B0034 | Boomerang St & Hale St | 1.8200 | 1.8200 | $334,917.36 |
| B0482 | Hardgrave Rd & Vulture St | 1.7600 | 2.2000 | $333,662.26 |
| B0525 | Newnham Rd & Wecker Rd | 1.7600 | 2.2000 | $333,662.26 |
| M1415 | Mt Gravatt - Capalaba Rd/Griffith Arterial Rd & Logan Sub-Arterial Rd | 1.3000 | 5.4600 | $331,750.18 |
| M1640 | Fedrick St/Green Rd & Mt Lindesay Hwy | 1.3200 | 5.2000 | $329,203.05 |
| M2432 | Kingston Rd & Paradise Rd (Aka Springwood Conn. Rd) | 1.8200 | 1.5600 | $329,134.64 |
| M5937 | Main St/Centenary Hwy Ramp & Sinnathamby Blvd | 1.7600 | 1.8200 | $325,210.60 |
| M6048 | Ruthven St/New England Hwy & Stenner St | 1.7600 | 1.8200 | $325,210.60 |
| B0306 | Herston Rd & Kelvin Grove Rd | 1.7600 | 1.7600 | $323,876.12 |
| M3104 | Bruce Hwy/Mulgrave Rd & Ishmael Rd/Thomson St | 1.7600 | 1.7600 | $323,876.12 |
| M1332 | Capalaba - Cleveland Rd & St Anthonys Dr/Windemere Rd | 1.8200 | 1.3000 | $323,351.92 |
| M4002 | Bridge Rd & Nebo Rd | 1.8200 | 1.3000 | $323,351.92 |
| M2411 | Kingston Rd (Brisbane - Beenleigh Rd) & Monash Rd | 1.5600 | 3.1200 | $321,768.33 |
| M5012 | Southport - Nerang Rd & Wardoo St | 1.5600 | 3.1200 | $321,768.33 |
| B0054 | Brunswick St & McLachlan St | 1.5600 | 3.0800 | $320,878.68 |
| M1419 | Logan Sub-Arterial Rd (U90) & Miles Platting Rd/Padstow Rd | 1.3000 | 4.9400 | $320,184.74 |
| M1209 | East - West Arterial Rd (1/04) & Nudgee Rd | 1.7600 | 1.5600 | $319,427.88 |
| M3220 | Dalrymple Rd & Duckworth St/Nathan St/Bruce Hwy (Douglas Garbutt rd. & Garbutt Upper ross Rd) | 1.7600 | 1.5600 | $319,427.88 |
| M7217 | Caloundra Rd & Parklands Blvd/Pierce Ave | 1.7600 | 1.5600 | $319,427.88 |
| M2196 | Anzac Ave (Redcliffe Rd) & Discovery Dr/Halpine Dr | 1.3200 | 4.6800 | $317,637.61 |
| M3338 | Mather St & Woolcock St (Do Not Use) | 1.8200 | 1.0400 | $317,569.20 |
| C5096 | Cheltenham Dr & Robina Parkway | 1.5600 | 2.8600 | $315,985.61 |
| B0377 | Bracken Ridge Rd & Norris Rd | 1.7600 | 1.3200 | $314,089.99 |
| M2748 | Brisbane St & East St | 1.7600 | 1.3200 | $314,089.99 |
| M6034 | Bridge St & Hume St | 1.7600 | 1.3200 | $314,089.99 |
| B0713 | Blunder Rd & Freeman Rd/Oakmont Ave | 1.7600 | 1.3000 | $313,645.16 |
| L1642 | Forestdale Dr & Johnson Rd (From '08) | 1.7600 | 1.3000 | $313,645.16 |
| L2502 | Logan Mwy & Loganlea Rd | 1.7600 | 1.3000 | $313,645.16 |
| L1638 | Browns Plains Rd & Grand Plaza Dr (Aka West Mall Dr)/Plains Junction Shopping Centre Accs | 1.3200 | 4.4200 | $311,854.89 |
| B0055 | Ann St & Brookes St/Wandoo St | 1.5600 | 2.6000 | $310,202.89 |
| M1111 | Gympie Rd/Gympie Arterial Rd & Kitchener Rd/Sport St | 1.5600 | 2.6000 | $310,202.89 |
| M2463 | Ewing Rd & Wembley Rd (Springwood Connection R) | 1.5600 | 2.6000 | $310,202.89 |
| M5934 | Alice St & Queen St | 1.5600 | 2.6000 | $310,202.89 |
| M2249 | Klingner Rd & Oxley Ave | 1.7600 | 1.0400 | $307,862.44 |
| M3182 | Kennedy Hwy & Myola Rd | 1.7600 | 1.0400 | $307,862.44 |
|  | Doherty St & Kremzow Rd | 1.7600 | 0.8800 | $304,303.85 |
| M2113 | Collins Rd (Code To 16315) & Old Northern Rd | 1.7600 | 0.8800 | $304,303.85 |
| M3309 | Bruce Hwy & Hervey Range Rd S | 1.7600 | 0.8800 | $304,303.85 |
| M4014 | Glenpark St & Malcomson St | 1.7600 | 0.8800 | $304,303.85 |
| M5073 | Hansford Rd & Oxley Dr | 1.7600 | 0.8800 | $304,303.85 |
| M7063 | Bribie Island Rd & Bruce Hwy Ramp S | 1.7600 | 0.8800 | $304,303.85 |
| M5385 | Pacific Hwy & Smith St Connection Rd/Heslop St E | 1.7600 | 0.7800 | $302,079.72 |
|  | Gray St/Chelmsford Ave & Ipswich - Cunningham Hwy Connection Rd | 1.8200 | 0.2600 | $300,221.04 |
| M1343 | Brisbane - Redland Rd (1/04) & Mt Cotton Rd | 1.5600 | 2.0800 | $298,637.46 |
| M2435 | Jacaranda Ave/Juers St & Kingston Rd | 1.5600 | 2.0800 | $298,637.46 |
| M3101 | Mulgrave Rd & Toogood Rd | 1.5600 | 2.0800 | $298,637.46 |
|  | Dohles Rocks Rd & Ogg Rd | 1.7600 | 0.5200 | $296,297.01 |
| M1330 | Old Cleveland Rd & Banfield La/Raymond St | 1.7600 | 0.5200 | $296,297.01 |
| M3122 | Bruce Hwy/Florence St & Mcleod St | 1.7600 | 0.5200 | $296,297.01 |
| M1517 | Cornwall St & Duke St | 1.5600 | 1.8200 | $292,854.74 |
| M5367 | Hope Island Rd (1/04) & Pacific Hwy (1/04) | 1.3200 | 3.5200 | $291,837.79 |
| M8028 | Kittyhawk Dr & Murphy Rd | 1.3200 | 3.5200 | $291,837.79 |
| M3146 | Mclaughlin Rd & Roberts Rd/Swallow Rd | 1.5600 | 1.5600 | $287,072.02 |
| M1623 | Beaudesert Rd (Use After 1/95) & Bradman St | 1.3000 | 3.3800 | $285,488.43 |
| M5322 | Parklands Dr & Smith St (Smith St Connection Rd) | 1.3000 | 3.3800 | $285,488.43 |
| M6049 | Alderley St & Ruthven St/New England Hwy | 1.7600 | 0.0000 | $284,731.57 |
| C5444 | Abraham Rd/Hargraves Rd & Reserve Rd | 1.3200 | 3.0800 | $282,051.65 |
| M2778 | Ipswich - Warrego Hwy Connection Rd & Lowry St | 1.3200 | 3.0800 | $282,051.65 |
| M2723 | Brisbane Rd (Ipswich - Cunningham Hwy Connection Rd) & Green St | 1.5600 | 1.3200 | $281,734.13 |
| M5590 | Abraham Rd & Days Rd | 1.5600 | 1.3000 | $281,289.30 |
| M5173 | Arundel Dr & Gold Coast Hwy | 1.3000 | 3.1200 | $279,705.71 |
| M5089 | Southport - Burleigh Rd & Reedy Creek Rd (Burleigh Connection Rd) | 1.3200 | 2.8600 | $277,158.58 |
| M1660 | Beaudesert Rd & Highlands Drive | 1.3000 | 2.8600 | $273,922.99 |
| B0670 | Colebrook Ave/Gow St & Ipswich Rd | 1.3200 | 2.6400 | $272,265.51 |
| L2450 | Baker St & Compton Rd | 1.3200 | 2.6400 | $272,265.51 |
| B0282 | Castlemaine St & Milton Rd (or Hale St Off Ramp (Southbound) & Milton Rd) | 1.3200 | 2.6000 | $271,375.86 |
| M1630 | Browns Plains Rd/Johnson Rd & Mt Lindesay Hwy | 1.3200 | 2.6000 | $271,375.86 |
| M3123 | Sheridan St/Captain Cook Hwy & Grove St | 1.5600 | 0.7800 | $269,723.86 |
| B0705 | Compton Rd & Persse Rd | 1.3000 | 2.6400 | $269,029.92 |
| B0776 | Cannondale St/Southgate Ave & Wynnum Rd | 1.3000 | 2.6400 | $269,029.92 |
| M1344 | Birkdale Rd/Moreton Bay Rd & Redland Bay Rd | 1.3000 | 2.6000 | $268,140.28 |
| M2260 | Deception Bay Rd & Morris Rd | 1.3000 | 2.6000 | $268,140.28 |
| B0132 | Boomerang St & Coronation Dr | 1.0400 | 4.4200 | $266,556.69 |
| M1231 | Braun St/Deagon Deviation & Board St/Depot Rd | 1.0400 | 4.4200 | $266,556.69 |
| C5069 | Kumbari Ave & Musgrave Ave | 1.3200 | 2.3400 | $265,593.14 |
| M2440 | Jacaranda Ave/Railway Pde & Wembley Rd (Springwood Connection Rd) | 1.3200 | 2.3400 | $265,593.14 |
| M5366 | Hope Island Rd (1/04) & Pacific Hwy (1/04) | 1.3200 | 2.3400 | $265,593.14 |
| B0201 | Green Tce/Cox Rd & Newmarket Rd | 1.3200 | 2.2000 | $262,479.37 |
| M5651 | Nerang Connection Rd (Gaven Way) & North St | 1.3200 | 2.2000 | $262,479.37 |
| B0029 | Croydon St/Jephson St & Sylvan Rd | 1.3000 | 2.3400 | $262,357.56 |
| M6038 | Bridge St & Tor St/Warrego Hwy | 1.3000 | 2.3400 | $262,357.56 |
| C5562 | Commercial St/Coomera Grand Dr & Old Coach Rd | 1.3200 | 2.0800 | $259,810.42 |
| C5605 | Dixon Dr & Yawalpah Rd | 1.3200 | 2.0800 | $259,810.42 |
| M2497 | Brisbane - Beenleigh Rd & Brookvale Dr/Ferguson St | 1.3200 | 2.0800 | $259,810.42 |
|  | Caboolture River Rd & Grant Rd | 1.3200 | 1.7600 | $252,693.23 |
|  | Markeri St & Rio Vista Blvd | 1.3200 | 1.7600 | $252,693.23 |
| B0263 | Newmarket Rd & Wilston Rd | 1.3200 | 1.7600 | $252,693.23 |
| M1663 | Logan Mwy & Paradise Rd E | 1.3200 | 1.7600 | $252,693.23 |
| M3424 | Brinsmead Rd & Redlynch Bypass Rd (Do Not Use) | 1.3200 | 1.7600 | $252,693.23 |
| M5550 | Executive Dr & Southport - Burleigh Rd (Bermuda St) | 1.3000 | 1.8200 | $250,792.12 |
| B0252 | Albion Overpass & Hudson Rd | 1.3000 | 1.7600 | $249,457.65 |
| M1232 | Braun St & Loftus St | 1.3000 | 1.7600 | $249,457.65 |
| M7051 | Bruce Hwy Ramp S & Uhlmann Rd | 1.0400 | 3.6400 | $249,208.53 |
| B0579 | Hellawell Rd & Pinelands Rd | 1.3200 | 1.5600 | $248,244.99 |
| M1201 | Fison Ave W/Southern Cross W Ramp & Kingsford Smith Dr | 1.3200 | 1.5600 | $248,244.99 |
| M3215 | Hugh St/North Ward Rd & Ingham Rd | 1.3200 | 1.5600 | $248,244.99 |
| C5077 | Nind St & Scarborough St | 1.3000 | 1.5600 | $245,009.40 |
| M1506 | North Quay/Herschel St & South East Art Rd Ramp A | 1.0400 | 3.3800 | $243,425.81 |
| M5491 | High St/Southport - Burleigh Rd & North St/Smith St Connection Rd (1/04) | 1.0400 | 3.3800 | $243,425.81 |
|  | Coldridge St & Sir Fred Schonell Dr | 1.3200 | 1.3200 | $242,907.09 |
| B0242 | Bilsen Rd & Hamilton Rd | 1.3200 | 1.3200 | $242,907.09 |
| B0758 | Corsair Ave & Inala Ave | 1.3200 | 1.3200 | $242,907.09 |
| L1639 | Browns Plains Rd & Second Ave/Waratah Dr | 1.3200 | 1.3200 | $242,907.09 |
| M1921 | Ellworthy St & Samford Rd (1/04) | 1.3200 | 1.3200 | $242,907.09 |
| M2155 | Anzac Ave & School Rd | 1.3200 | 1.3200 | $242,907.09 |
| M2482 | Loganlea Rd & Nujooloo Rd | 1.3200 | 1.3200 | $242,907.09 |
| M3111 | Florence St & Sheridan St (aka Captain Cook Hwy & Mulgrave Rd) | 1.3200 | 1.3200 | $242,907.09 |
| M5461 | Alexander Dr/Nielsens Rd & Pacific Hwy Ramp | 1.3200 | 1.3200 | $242,907.09 |
| M6020 | Margaret St & West St | 1.3200 | 1.3200 | $242,907.09 |
| M6022 | Bridge St & West St | 1.3200 | 1.3200 | $242,907.09 |
| M6052 | Stenner St & West St | 1.3200 | 1.3200 | $242,907.09 |
| B0622 | Creek Rd & Greenmeadow Rd/Tristania Wy | 1.3200 | 1.3000 | $242,462.27 |
| M1398 | Gateway Arterial Rd & Lytton Rd (1/95) | 1.3200 | 1.3000 | $242,462.27 |
| M2244 | MacDonnell Rd & Oxley Ave | 1.3200 | 1.3000 | $242,462.27 |
| M3257 | Balls La/Cross St & Ross River Rd | 1.3200 | 1.3000 | $242,462.27 |
| M4049 | Rockleigh - North Mackay Rd & Sams Rd | 1.3200 | 1.3000 | $242,462.27 |
| M1645 | Central Ct/Mt Lindesay Hwy Ramp & Johnson Rd | 0.8800 | 4.4200 | $240,672.00 |
| B0489 | Boundary Rd/Holland Rd & Cavendish Rd | 1.3000 | 1.3200 | $239,671.51 |
| B0004 | Ann St & Edward St | 1.3000 | 1.3000 | $239,226.68 |
| B0043 | Bowen Bridge Rd/Brunswick St & Gregory Tce | 1.3000 | 1.3000 | $239,226.68 |
| M1619 | Beaudesert Rd & O'Connel St | 1.3000 | 1.3000 | $239,226.68 |
| M2233 | Anzac Ave & Deception Bay Rd & McGahey St | 1.0400 | 3.1200 | $237,643.09 |
| B0463 | Eastern Busway/O'Keefe St & Ipswich Rd | 1.3200 | 1.0400 | $236,679.55 |
| B0741 | Archerfield Rd & Poinsettia St/Progress Rd | 1.3200 | 1.0400 | $236,679.55 |
| M1722 | Centenary Hwy/Western Art Rd Ramp Fa/Fb & Fig Tree Pocket Rd | 1.3200 | 1.0400 | $236,679.55 |
| M3310 | Bruce Hwy & Hervey Range Rd N | 1.3200 | 1.0400 | $236,679.55 |
| M1621 | Beaudesert Rd & Fox Rd/Paradise Rd | 1.3000 | 1.0400 | $233,443.96 |
|  | Dean St & Elphinstone St | 1.3200 | 0.8800 | $233,120.95 |
| B0210 | Moggill Rd (1/04) & Whitmore St | 1.3200 | 0.8800 | $233,120.95 |
| C5117 | Gold Coast Hwy & Waterways Dr | 1.0400 | 2.8600 | $231,860.38 |
| M1624 | Beaudesert Rd & Hellawell Rd/Learoyd Rd | 1.0400 | 2.8600 | $231,860.38 |
| M1335 | Allenby Rd/Vienna Rd & Finucane Rd/Capalaba - Cleveland Rd (1/04) | 1.3200 | 0.7800 | $230,896.83 |
| M1416 | Link St & Logan Sub-Arterial Rd (U90) | 1.3200 | 0.7800 | $230,896.83 |
| M5382 | Gold Coast Hwy/Binstead Wy & Heslop Rd/Entertainment Rd | 1.3200 | 0.7800 | $230,896.83 |
| M7019 | Bellmere Rd & King St | 1.3200 | 0.7800 | $230,896.83 |
| M7031 | Morayfield Rd & William Berry Dr | 1.3200 | 0.7800 | $230,896.83 |
| M7094 | Bruce Hwy On Ramp N & Uhlmann Rd (Burpengary - Caboolture Rd) | 1.3200 | 0.7800 | $230,896.83 |
| B0837 | Daw Rd & Warrigal Rd | 0.8800 | 3.9000 | $229,106.56 |
| B0486 | Birdwood Rd & Logan Rd (1/95) | 1.0400 | 2.6400 | $226,967.31 |
| M3172 | Bruce Hwy & Foster Rd | 1.3200 | 0.5200 | $225,114.11 |
| M7603 | Maryborough - Hervey Bay Rd, Ferry St & Walker St | 1.3200 | 0.5200 | $225,114.11 |
| M1116 | Gympie Arterial Rd (1/04) & Hamilton Rd | 0.8800 | 3.6400 | $223,323.84 |
| B0197 | Abbotsford Rd/Markwell St & Campbell St/Montpelier Rd | 1.0400 | 2.3400 | $220,294.94 |
| M1651 | Balham Rd & Granard Rd/Griffith Arterial Rd | 1.0400 | 2.3400 | $220,294.94 |
| M1135 | Albany Creek Sub-Arterial Rd (From 2004) & Beckett Rd/Bridgeman Rd | 1.3200 | 0.2600 | $219,331.39 |
| B0479 | Main St & River Tce/Quinton St | 0.7800 | 3.9000 | $212,928.63 |
| L2488 | Edenlea Dr/Logandowns Dr & Loganlea Rd | 0.8800 | 3.1200 | $211,758.41 |
| M7014 | Bay Ave & Deception Bay Rd | 0.8800 | 3.1200 | $211,758.41 |
| B0038 | Bowen Bridge Rd & O'Connell Tce/Central Dr | 1.0400 | 1.8200 | $208,729.50 |
| B0079 | Milton Rd & Park Ave | 1.0400 | 1.8200 | $208,729.50 |
| M2475 | Ellen St/Opal St & Kingston Rd (Brisbane - Beenleigh Rd) | 1.0400 | 1.8200 | $208,729.50 |
| M7202 | Nicklin Wy & Marawa Dr/Point Cartwright Dr | 1.0400 | 1.8200 | $208,729.50 |
| M3107 | Brown St & Mulgrave Rd/Bruce Hwy | 1.0400 | 1.7600 | $207,395.03 |
| B0491 | Beenleigh Rd & Mains Rd/Pinelands Rd | 0.7800 | 3.6400 | $207,145.91 |
| B0562 | Calam Rd/Calamvale Hotel Motel Accs & Compton Rd | 0.7800 | 3.6400 | $207,145.91 |
| M5165 | Gold Coast Hwy & Toolona St | 0.7800 | 3.6400 | $207,145.91 |
| B0083 | Bowen Bridge Rd & Butterfield St | 1.0400 | 1.5600 | $202,946.78 |
| B0084 | Ann St & Warner St | 1.0400 | 1.5600 | $202,946.78 |
| M5306 | Executive Dr/Taree St & Reedy Creek Rd | 1.0400 | 1.5600 | $202,946.78 |
| C5093 | Bacardi Ct/Melody St & Sunshine Blvd | 0.8800 | 2.6400 | $201,082.62 |
| M7007 | Beerburrum Rd/Morayfield Rd & King St | 0.8800 | 2.6000 | $200,192.97 |
| B0874 | Arenga St/Link St & Manly Rd | 1.0400 | 1.3200 | $197,608.89 |
| M1968 | Frasers Rd & Stewart Rd/Wardell St | 1.0400 | 1.3200 | $197,608.89 |
| B0046 | Airport Link On Ramp/Campbell St & Hamilton Pl/Mayne Rd | 1.0400 | 1.3000 | $197,164.06 |
| M2247 | Anzac Ave & Oxley Ave | 1.0400 | 1.3000 | $197,164.06 |
| M7021 | Burpengary - Caboolture Rd & Walkers Rd | 1.0400 | 1.3000 | $197,164.06 |
| B0414 | Vulture St & Wellington Rd | 0.8800 | 2.3400 | $194,410.25 |
| M1525 | Bapaume Rd/ Birdwood Rd & Marshall Rd | 0.8800 | 2.3400 | $194,410.25 |
| M1978 | Appleby Rd/Shand St & East - West Arterial Rd (1/04) | 0.8800 | 2.3400 | $194,410.25 |
|  | Chambers Flat Rd & Kingston Rd/Brisbane - Beenleigh Rd | 1.0400 | 1.0400 | $191,381.35 |
| B0435 | Ernest St & Merivale St | 1.0400 | 1.0400 | $191,381.35 |
| B0578 | Container St/Victor St & Wynnum Rd | 1.0400 | 1.0400 | $191,381.35 |
| C5191 | Remembrance Dr & Gold Coast Hwy/Surfers Paradise Blvd | 1.0400 | 1.0400 | $191,381.35 |
| M2169 | Anzac Ave & Brays Rd | 1.0400 | 1.0400 | $191,381.35 |
| M3142 | Cairns Western Arterial Rd (Brinsmead Rd) & Loridan Dr/View St | 1.0400 | 1.0400 | $191,381.35 |
| M5326 | Labrador - Carrara Rd & Smith St Connection Rd W | 1.0400 | 1.0400 | $191,381.35 |
| M7148 | Cornmeal Pde & Maroochydore - Mooloolaba Rd | 1.0400 | 1.0400 | $191,381.35 |
|  | Kayleigh Dr & Wises Rd | 0.8800 | 2.2000 | $191,296.48 |
| C5420 | Christine Ave & Lemana La | 0.8800 | 2.2000 | $191,296.48 |
| M1627 | Beaudesert Rd & Ormskirk St | 0.7800 | 2.8600 | $189,797.76 |
| M5027 | Nerang - Broadbeach Rd & Rio Vista Blvd | 0.7800 | 2.8600 | $189,797.76 |
| M7288 | Mountain Creek Rd (Tanahawa Tourist Dr)/Sippy Downs Dr & Sunshine Mwy Ramp | 0.8800 | 2.0800 | $188,627.53 |
| M2449 | Compton Rd/Lexington Rd & Logan Sub-Arterial Rd | 0.5200 | 4.6800 | $188,214.17 |
|  | Johnson Rd (From '08) & Stapylton Rd | 1.0400 | 0.8800 | $187,822.75 |
| C5321 | Captain Cook Dr/Parkwood Blvd & Napper Rd | 1.0400 | 0.8800 | $187,822.75 |
| B0400 | Grey St & Melbourne St | 1.0400 | 0.7800 | $185,598.63 |
| B0569 | Beenleigh Rd & Wynne St | 1.0400 | 0.7800 | $185,598.63 |
| C5353 | Christine Ave & Mattocks Rd | 1.0400 | 0.7800 | $185,598.63 |
| L1661 | Browns Plains Rd & Downing St | 1.0400 | 0.7800 | $185,598.63 |
| M3173 | Bruce Hwy/Florence St & Martyn St | 1.0400 | 0.7800 | $185,598.63 |
| M7011 | Charles St & Lower King St | 1.0400 | 0.7800 | $185,598.63 |
| C5499 | Collyer Quays & Robina Town Centre Dr E | 0.7800 | 2.6400 | $184,904.69 |
| M5082 | Labrador - Carrara Rd/Olsen Ave & Parklands Dr/Wintergreen Dr | 0.7800 | 2.6000 | $184,015.04 |
|  | Collingwood Dr & Eagle St | 0.8800 | 1.8200 | $182,844.81 |
| B0012 | Adelaide St & Wharf St | 0.8800 | 1.8200 | $182,844.81 |
| B0518 | Beenleigh Rd & Penarth St | 0.8800 | 1.8200 | $182,844.81 |
| B0656 | Beenleigh Rd & Persse Rd | 0.8800 | 1.8200 | $182,844.81 |
| M2452 | Fitzgerald Ave/Rochedale Rd & Logan Rd/Pacific Hwy Ramp | 0.8800 | 1.8200 | $182,844.81 |
| M5234 | Brisbane - Beenleigh Rd & Gardiner Rd | 0.8800 | 1.8200 | $182,844.81 |
| M5591 | Foxwell Rd/Coomera Overpass & Old Pacific Hwy | 0.8800 | 1.8200 | $182,844.81 |
|  | Biota St & Rosemary St | 0.8800 | 1.7600 | $181,510.34 |
| C5323 | Allandale Ent & Markeri St | 0.8800 | 1.7600 | $181,510.34 |
| M6016 | Bridge St & Ruthven St/New England Hwy | 0.8800 | 1.7600 | $181,510.34 |
| M5384 | Pacific Hwy & Smith St Connection Rd/Heslop St W | 1.0400 | 0.5200 | $179,815.91 |
| B0098 | Eildon Rd/Legeyt St & Lutwyche Rd | 0.7800 | 2.3400 | $178,232.32 |
| B0534 | Mains Rd & Shearwin St | 0.7800 | 2.3400 | $178,232.32 |
| B0608 | Beenleigh Rd & Gowan Rd | 0.7800 | 2.3400 | $178,232.32 |
| B0690 | Old Cleveland Rd & Scrub Rd | 0.7800 | 2.3400 | $178,232.32 |
| M1216 | Rode Rd & Sandgate Sub-Arterial Rd (1/04) | 0.7800 | 2.3400 | $178,232.32 |
| B0633 | Creek Rd & Donnington St/Gallipoli Rd | 0.8800 | 1.5600 | $177,062.10 |
| C5115 | Gold Coast Hwy & Marine Pde roundabout | 0.8800 | 1.5600 | $177,062.10 |
| M2702 | Brisbane Rd (Code To 84351) & Old Logan Rd (From 2008) | 0.8800 | 1.5600 | $177,062.10 |
| M3358 | Stuart Dr & University Rd | 0.8800 | 1.5600 | $177,062.10 |
| M5172 | Brisbane Rd & Turpin Rd | 0.7800 | 2.2000 | $175,118.55 |
| B0139 | Cribb St & Milton Rd | 0.7800 | 2.0800 | $172,449.60 |
| M1114 | Gympie Rd & Kuran St/Wallace St | 0.7800 | 2.0800 | $172,449.60 |
| M1120 | Darwin St & Gympie Arterial Rd | 0.7800 | 2.0800 | $172,449.60 |
| M1131 | Banfield St & Gympie Arterial Rd (1/04) | 0.7800 | 2.0800 | $172,449.60 |
| M1226 | Beams Rd/Stanworth Rd & Sandgate Rd | 0.7800 | 2.0800 | $172,449.60 |
| M2736 | Brisbane Rd/Cunningham Hwy Ramp & River Rd/Aberdare St | 0.7800 | 2.0800 | $172,449.60 |
| M5113 | Gold Coast Hwy & Marine Pde/ North St | 0.7800 | 2.0800 | $172,449.60 |
| M5581 | Camp Cable Rd & Waterford - Tamborine Rd | 0.7800 | 2.0800 | $172,449.60 |
| B0226 | Payne Rd & Waterworks Rd | 0.8800 | 1.3200 | $171,724.20 |
| B0230 | Adelaide St & Sandgate Rd (1/04) | 0.8800 | 1.3200 | $171,724.20 |
| B0352 | George St & Mary St | 0.8800 | 1.3200 | $171,724.20 |
| M5167 | Gold Coast Hwy & Terminal Dr/Eastern Ave | 0.8800 | 1.3200 | $171,724.20 |
| M5517 | Matthew Flinders Dr & Oxley Dr | 0.8800 | 1.3200 | $171,724.20 |
| M6074 | Drayton Rd & South St | 0.8800 | 1.3200 | $171,724.20 |
| M7132 | Golf Links Rd/Pheasant St & Mooloolaba Rd | 0.8800 | 1.3200 | $171,724.20 |
| B0246 | Beams Rd & Muller Rd | 0.8800 | 1.3000 | $171,279.38 |
| B0668 | Cracknell Rd/Villa St & Ipswich Rd | 0.8800 | 1.3000 | $171,279.38 |
| B0738 | Radford Rd & Wondall Rd | 0.8800 | 1.3000 | $171,279.38 |
| L1637 | Browns Plains Rd & Grand Plaza Dr (Aka West Mall Dr) | 0.8800 | 1.3000 | $171,279.38 |
| M1518 | Cornwall St & Earl St/Junction St | 0.8800 | 1.3000 | $171,279.38 |
| M3108 | Aumuller St & Mulgrave Rd/Bruce Hwy | 0.8800 | 1.3000 | $171,279.38 |
| M5178 | Broad St/Marine Pde & Frank St (Gold Coast Hwy) | 0.8800 | 1.3000 | $171,279.38 |
| M5227 | Brisbane - Beenleigh Rd & Holmview Rd | 0.8800 | 1.3000 | $171,279.38 |
| M7025 | Beerburrum Rd & Bertha St | 0.8800 | 1.3000 | $171,279.38 |
| M5021 | Southport - Burleigh Rd & Thomas Dr/Slatyer Ave | 0.5200 | 3.9000 | $170,866.01 |
|  | Kingston Rd & Logan Rd (1/95) | 0.7800 | 1.8200 | $166,666.88 |
| M1320 | Cleveland Sub-Arterial Rd (1/95) & Tilley Rd | 0.7800 | 1.8200 | $166,666.88 |
| M5801 | Jones Rd & Keidges Rd/Redbank Plains Rd | 0.7800 | 1.8200 | $166,666.88 |
| B0442 | Beenleigh Rd & Datura St | 0.8800 | 1.0400 | $165,496.66 |
| B0492 | Belmont Rd/Wynnum Rd & Manly Rd | 0.8800 | 1.0400 | $165,496.66 |
| L2405 | Anderson St/Macquarie Way & Wembley Rd (1/95) | 0.8800 | 1.0400 | $165,496.66 |
| M2489 | Beenleigh-Redland Bay Rd & California Ck Rd/Montessa St | 0.8800 | 1.0400 | $165,496.66 |
| M2532 | Pacific Hwy (1/04) & Winnetts Rd | 0.8800 | 1.0400 | $165,496.66 |
| M3263 | Garbutt - Upper Ross Rd & Gouldian Ave | 0.8800 | 1.0400 | $165,496.66 |
| M5460 | Nielsens Rd & Pacific Hwy Off Ramp (Southbound)/Spencer Rd | 0.8800 | 1.0400 | $165,496.66 |
| M7072 | Bribie Island Rd (Caboolture - Bribie Island Rd) & Pasturage Rd | 0.8800 | 1.0400 | $165,496.66 |
| M1912 | Samford Rd (1/04) & Upper Kedron Rd | 0.7800 | 1.7600 | $165,332.41 |
| M1650 | Beatty Rd & Granard Rd | 0.5200 | 3.6400 | $165,083.30 |
|  | Edwards St & Raceview St | 0.8800 | 0.8800 | $161,938.06 |
|  | Nerang - Broadbeach Rd & Nerang Connection Rd (Gaven Way) | 0.7800 | 1.5600 | $160,884.17 |
| B0614 | Logan Rd & Shire Rd/Selborne St | 0.7800 | 1.5600 | $160,884.17 |
| C5122 | Ferny Ave & Ocean Ave | 0.7800 | 1.5600 | $160,884.17 |
| M2467 | Bardon Rd & Wembley Rd (Springwood Connection Rd) | 0.7800 | 1.5600 | $160,884.17 |
| M3103 | Balaclava Rd & Mulgrave Rd/Bruce Hwy | 0.7800 | 1.5600 | $160,884.17 |
| M7022 | Bailey Rd & Deception Bay Rd | 0.7800 | 1.5600 | $160,884.17 |
|  | Collingwood Dr & Redbank Plains Rd (02/13) | 0.8800 | 0.7800 | $159,713.94 |
|  | English St & Hoare St | 0.8800 | 0.7800 | $159,713.94 |
|  | Manchester Rd & Nerang - Broadbeach Rd | 0.8800 | 0.7800 | $159,713.94 |
|  | Parklands Blvd & Sunset Dr | 0.8800 | 0.7800 | $159,713.94 |
| M2237 | Hornibrook Esp & Maine Rd | 0.8800 | 0.7800 | $159,713.94 |
| M2466 | Kingston Rd (Brisbane - Beenleigh Rd) & Station Rd | 0.5200 | 3.3800 | $159,300.58 |
| M2119 | Albany Forest Dr & Old Northern Rd (Everton Park - Albany Creek Rd) | 0.7800 | 1.3200 | $155,546.27 |
| M2437 | Clare Rd/Marshall St & Kingston Rd | 0.7800 | 1.3200 | $155,546.27 |
| M6017 | Jellicoe St & Ruthven St/New England Hwy | 0.7800 | 1.3200 | $155,546.27 |
| B0480 | Deshon St/Qualtrough St & Logan Rd | 0.5200 | 3.0800 | $152,628.21 |
| B0730 | Edmondstone St & Melbourne St | 0.7800 | 1.0400 | $149,318.73 |
| M2115 | Jinker Track & Old Northern Rd | 0.7800 | 1.0400 | $149,318.73 |
| M5390 | Crestwood Dr/Griffith Wy & Olsen Av | 0.7800 | 1.0400 | $149,318.73 |
| M3259 | Alfred St & Douglas - Garbutt Rd | 0.5200 | 2.8600 | $147,735.14 |
| M5462 | Alexander Dr & Hinkler Dr (7/13) | 0.7800 | 0.8800 | $145,760.13 |
| B0693 | Annerley Rd & Ipswich Rd | 0.7800 | 0.7800 | $143,536.01 |
| M2183 | Anzac Ave & Sutton St | 0.7800 | 0.7800 | $143,536.01 |
| M5402 | Alabaster Dr & Nerang - Broadbeach Rd | 0.7800 | 0.7800 | $143,536.01 |
| M5971 | Reif St & Ripley Rd | 0.7800 | 0.7800 | $143,536.01 |
| B0718 | Beenleigh Rd & Stones Rd | 0.5200 | 2.6400 | $142,842.07 |
| M5316 | Bourton Rd/Jura Pde & Gooding Dr (Gold Coast - Springbrook Rd) | 0.5200 | 2.6400 | $142,842.07 |
| B0056 | Brookes St & Wickham St | 0.5200 | 2.6000 | $141,952.42 |
| M1457 | Griffith Arterial Rd (U20 -1/95) & Springfield St | 0.5200 | 2.6000 | $141,952.42 |
| M1628 | Beaudesert Rd & Muirhead St/Kameruka St | 0.5200 | 2.6000 | $141,952.42 |
| B0070 | Lutwyche Rd & Newmarket Rd | 0.5200 | 2.3400 | $136,169.70 |
| B0088 | Coronation Dr & Sylvan Rd | 0.5200 | 2.3400 | $136,169.70 |
| B0309 | Ashgrove Ave/Edmonston St & Enoggera Rd | 0.5200 | 2.3400 | $136,169.70 |
| M1308 | Mt Gravatt - Capalaba Rd & Redland Sub-Arterial Rd (state route 21) | 0.5200 | 2.3400 | $136,169.70 |
| B0685 | Jones Rd & Old Cleveland Rd (1/95) | 0.4400 | 2.8600 | $134,792.80 |
| M0644 | Garden Rd & Progress Rd | 0.4400 | 2.8600 | $134,792.80 |
| B0704 | Stanley St & Trinity La/South East Arterial Ramps | 0.2600 | 4.1600 | $134,586.11 |
| M5810 | Collingwood Dr & Smiths Rd | 0.5200 | 2.2000 | $133,055.93 |
| B0715 | Blunder Rd & Glenala Rd | 0.5200 | 2.0800 | $130,386.98 |
| B0767 | Lumphanan St & Pinelands Rd | 0.5200 | 2.0800 | $130,386.98 |
| L1670 | Browns Plains Rd & Fourth Ave/Warbler St | 0.5200 | 2.0800 | $130,386.98 |
| M1238 | Pritchard Rd & Sandgate Rd (1/04) | 0.5200 | 2.0800 | $130,386.98 |
| M5410 | Napper Rd & Smith St Connection Rd (1/04) | 0.5200 | 2.0800 | $130,386.98 |
| B0140 | Jephson St & Sherwood Rd | 0.4400 | 2.6400 | $129,899.73 |
| B0680 | Boundary Rd/Wiles St & Old Cleveland Rd (1/95) | 0.4400 | 2.6400 | $129,899.73 |
| B0873 | Gardner Rd & Miles Platting Rd | 0.4400 | 2.6400 | $129,899.73 |
| M5185 | Gold Coast Hwy (Brisbane Rd) & Marble Arch Pl/Lakeside Country Club Accs | 0.4400 | 2.6000 | $129,010.08 |
| B0086 | Baroona Rd/Park Rd & Milton Rd | 0.5200 | 1.8200 | $124,604.27 |
| B0599 | Creek Rd & Pine Mountain Rd | 0.5200 | 1.8200 | $124,604.27 |
| C5649 | Swan Rd & Yawalpah Rd | 0.5200 | 1.8200 | $124,604.27 |
| M1982 | East - West Arterial Rd & Stafford Rd/Webster Rd | 0.5200 | 1.8200 | $124,604.27 |
| L5208 | Fryar Rd & River Hills Rd | 0.4400 | 2.3400 | $123,227.36 |
| B0459 | Cavendish Rd & Chatsworth Rd | 0.4400 | 2.2000 | $120,113.59 |
| M2726 | Addison Rd & Cairns Rd | 0.4400 | 2.2000 | $120,113.59 |
| M5938 | Alawoona St & School Rd (Prev Redbank Plains | 0.4400 | 2.2000 | $120,113.59 |
|  | Griffith Arterial Rd (U20 -1/95) & Kessels Rd (Not Griffith Art. Rd) | 0.5200 | 1.5600 | $118,821.55 |
| B0402 | Beenleigh Rd & Warrigal Rd | 0.5200 | 1.5600 | $118,821.55 |
| B0719 | Hampstead Rd & Vulture St | 0.5200 | 1.5600 | $118,821.55 |
| B0774 | Gillingham St/S E Busway & O'Keefe St | 0.5200 | 1.5600 | $118,821.55 |
| M1218 | Hamilton Rd & Sandgate Rd (1/04) | 0.5200 | 1.5600 | $118,821.55 |
| M7013 | Deception Bay Rd & Webster Rd | 0.5200 | 1.5600 | $118,821.55 |
| M7218 | Lutana St & Nicklin Wy | 0.5200 | 1.5600 | $118,821.55 |
| M2420 | Levington Rd & Logan Rd (1/95) | 0.2600 | 3.3800 | $117,237.96 |
| M5026 | Nerang - Broadbeach Rd (Hooker Blvd) & Sunshine Blvd | 0.2600 | 3.3800 | $117,237.96 |
| M3155 | Lennon St & Mccormack St | 0.5200 | 1.3200 | $113,483.65 |
| M4609 | Breslin St & Dawson Hwy | 0.5200 | 1.3200 | $113,483.65 |
| M5045 | Burleigh St/James St & West Burleigh Rd | 0.5200 | 1.3200 | $113,483.65 |
| C5351 | Markeri St & Robina Parkway | 0.5200 | 1.3000 | $113,038.83 |
| M1418 | Holmead Rd & Logan Sub-Arterial Rd (U90) | 0.5200 | 1.3000 | $113,038.83 |
| M2492 | Beutel St/Remaro St & Kingston Rd/Brisbane - Beenleigh Rd | 0.5200 | 1.3000 | $113,038.83 |
| M3102 | Barr St & Mulgrave Rd/Bruce Hwy | 0.5200 | 1.3000 | $113,038.83 |
| B0061 | Gotha St & Wickham St | 0.4400 | 1.8200 | $111,661.92 |
| B0403 | Cordelia St & Ernest St | 0.4400 | 1.8200 | $111,661.92 |
| B0511 | Annerley Rd/Eastern Busway & Gladstone Rd | 0.4400 | 1.8200 | $111,661.92 |
| M5308 | Ashmore Rd & Currumburra Rd/Ross St (Labrador - Carrara Rd) | 0.2600 | 3.1200 | $111,455.24 |
|  | Dohles Rocks Rd & School Rd | 0.4400 | 1.7600 | $110,327.45 |
| M5328 | Tallebudgera Creek Rd & Tsipura Dr | 0.4400 | 1.7600 | $110,327.45 |
|  | Pacific Hwy (1/04) & Vanessa Blvd | 0.5200 | 1.0400 | $107,256.11 |
| B0682 | Creek Rd & Old Cleveland Rd (1/95) | 0.5200 | 1.0400 | $107,256.11 |
| C5120 | Ferny Ave & Gold Coast Hwy | 0.5200 | 1.0400 | $107,256.11 |
| M5031 | Ferry St & Price St | 0.5200 | 1.0400 | $107,256.11 |
| B0039 | Breakfast Ck Rd & Edmondstone Rd | 0.4400 | 1.5600 | $105,879.20 |
| B0900 | Padstow Rd & Warrigal Rd | 0.4400 | 1.5600 | $105,879.20 |
| B0277 | Felix St & Mary St | 0.4400 | 1.3200 | $100,541.31 |
| M2451 | Pacific Hwy Connection Rd & Pacific Hwy Ramp | 0.4400 | 1.3000 | $100,096.48 |
| B0404 | Stanley St & Vulture St (Dock/Graham) | 0.2600 | 2.6000 | $99,889.80 |
| B0541 | Beatty Rd & Mortimer Rd | 0.2600 | 2.3400 | $94,107.08 |
| B0092 | Allwood St/Belgrave Rd & Coonan St | 0.2600 | 2.2000 | $90,993.31 |
| B0209 | Abbotsford Rd & Folkestone St | 0.2600 | 2.0800 | $88,324.37 |
| L2505 | Compton Rd & North Rd | 0.2600 | 2.0800 | $88,324.37 |
| M5104 | Gold Coast Hwy (Tweed St) & Ikkina Rd | 0.2600 | 2.0800 | $88,324.37 |
| M5147 | Gold Coast Hwy & Markeri St | 0.2600 | 1.8200 | $82,541.65 |
| B0689 | Fifth Ave/Nicklin St & Old Cleveland Rd (1/95) | 0.2600 | 1.7600 | $81,207.17 |
| M1118 | Gympie Arterial Rd & Murphy Rd | 0.2600 | 1.5600 | $76,758.93 |
| M2404 | Battle St & Kingston Rd | 0.0000 | 3.3800 | $75,175.34 |
| M7016 | Beerburrum Rd & Mckean St | 0.2600 | 1.3200 | $71,421.04 |
| B0174 | Charlotte St & Edward St | 0.2600 | 1.3000 | $70,976.21 |
| M2185 | Anzac Ave & Bruce Hwy N | 0.2600 | 1.3000 | $70,976.21 |
| C5519 | Garden St/Waverley St & Southport - Nerang Rd | 0.0000 | 2.2000 | $48,930.70 |
| M1918 | Osborne Rd & Samford Rd (1/04) | 0.0000 | 2.2000 | $48,930.70 |
| B0787 | Blunder Rd/Stapylton Rd & Wadeville St | 0.0000 | 2.0800 | $46,261.75 |
| C5051 | Guineas Creek Rd/Sarawak Ave & K P Mcgrath Dr | 0.0000 | 2.0800 | $46,261.75 |
|  | Klumpp Rd & Mains Rd | 0.0000 | 1.8200 | $40,479.03 |
| C5511 | Cannes Ave/Wharf Rd & Gold Coast Hwy | 0.0000 | 1.8200 | $40,479.03 |
| M1719 | Cunningham Arterial Rd (Ipswhich Mwy Ramp) & Granard Rd | 0.0000 | 1.8200 | $40,479.03 |
| M5959 | Cemetery Rd & Whitehill Rd | 0.0000 | 1.8200 | $40,479.03 |
| B0585 | Allen St & Vulture St | 0.0000 | 1.5600 | $34,696.31 |
| B0699 | Compton Rd & Roosevelt Dr | 0.0000 | 1.5600 | $34,696.31 |
| B0716 | Musgrave Rd & Troughton Rd | 0.0000 | 1.5600 | $34,696.31 |
| M1350 | Redland Bay Rd (1/04) & Smith St | 0.0000 | 1.5600 | $34,696.31 |

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1. If the pre-period history of the control was less than 0.025 or more than 1.975 times the pre-period crash history of the matched treatment site, the control intersection was excluded. [↑](#footnote-ref-1)
2. Harlaxton Section [↑](#footnote-ref-2)
3. The westernmost halo for the Toowoomba Second Range Crossing was bound by the start of the road and is only 2.6 km in length. Halos of influence for this set of three P-t-P road lengths also included the two road lengths in between which were 6.1km and 1.7km in length. [↑](#footnote-ref-3)
4. The intersection sites for ten of the 21 RLSCs had RLCs installed and operational prior to 1993, so there was no opportunity to evaluate the effectiveness of the RLCs as data prior to RLC installation was unavailable and furthermore, defining a pre-treatment period so far prior to the camera installation would draw questions about the representativeness of the comparison. Consequently, analysis for those ten sites (site numbers 2005-2007 & 2010-2011, 2025 2029, 2103, 2105 & 2106) focused solely on assessing the crash effects of upgrading RLC sites to RLSC. [↑](#footnote-ref-4)