

Final Report

Evaluation of speed cameras in 40 km/h school speed zones

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for Roads and Traffic Authority, NSW

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Executive summary

Background

In an endeavour to improve road safety outside schools by lowering vehicle speeds, the NSW Roads and Traffic Authority (RTA) began installing 40 km/h regulatory school zone speed limits in 1992. In 2002, a large number of additional installations were completed to provide school zones at all primary schools. To also encourage increased compliance with this lower limit, the RTA undertook a trial of the operation of fixed speed cameras in conjunction with the 40 km/h school zone speed limit. The trial was undertaken at 10 school speed zone locations where the fixed digital speed cameras commenced full-time operations in July 2003.

Objective of the evaluation

The objective of the trial was to determine the impact of speed cameras on vehicle speeds at a sample of 40 km/h school speed zones in New South Wales. The impact of the devices was measured in terms of changes in speed behaviour (that is, the proportion of motorists speeding above pre-determined thresholds, mean speeds and 85th percentile speeds) occurring at the school zones and on both approaches to each school speed zone.

Speed survey periods

Speed surveys were carried out at each of the fixed digital speed camera sites and control sites:

- Just before installation of the fixed digital speed cameras during November and December 2002.
- Just after the commencement of operation of the fixed digital camera sites during July and August 2003¹.
- Three months following the commencement of operation of the fixed digital speed cameras during October and November 2003.
- Twelve months following the commencement of operation of the fixed digital speed cameras during August 2004.

Types of Zones

There were three types of zones:

- Type A - eight were 40 km/h school speed zones **with controls** (60 km/h during all other times)
- Type B - one was a 40 km/h school speed zone, **without a control**, (zoned 50 km/h during all other times)
- Type C -one was a 40 km/h school speed zone, **without a control**, (zoned 60 km/h during all other times).

¹ The cameras had been switched on before this but were only issuing warning notices. In this report, when cameras are referred to as operational it means that they were issuing infringement notices.

Key findings

The statistical analysis provides clear evidence of the immediate and sustained impact of the cameras in reducing speeds in the school zones. These reductions were apparent on all six indicators used including the higher vehicle speeds. There was a smaller but still beneficial impact on speeds on the approaches to the zones. In summary:

1. At the school zones, after 12 months

- mean speeds had reduced by
 - Type A - 9.6 km/h (21.6%)
 - Type B - 6.0 km/h (14.0%)
 - Type C - 15.5 km/h (29.8%).
- the 85th percentile speeds had reduced by:
 - Type A - 13.9 km/h (25.7%)
 - Type B - 8.8 km/h (17.2%)
 - Type C - 21.1 km/h (33.6%).
- the percentage of vehicles exceeding the speed limit had reduced from:
 - Type A - 76.1% to 15.0%
 - Type B - 65.1% to 21.5%
 - Type C - 84.9% to 19.0%.
- the percentage of vehicles exceeding the speed limit by more than 10 km/h had reduced from:
 - Type A - 39.4% to 2.1%
 - Type B - 16.6% to 2.4%
 - Type C - 59.3% to 4.8%.
- the percentage of vehicles exceeding the speed limit by more than 20 km/h had reduced from:
 - Type A - 8.9% to 0.2%
 - Type B - 1.8% to 0.2%
 - Type C - 21.8% to 0.5%.
- the percentage of vehicles exceeding the speed limit by more than 30 km/h reduced from:
 - Type A - 1.1% to zero
 - Type B - 0.1% to zero
 - Type C - 3.4% to zero.

2. On the approaches to the school zones, after 12 months

- mean speeds had reduced by
 - Type A - 1.6 km/h (3.1%)

Type B – 3.5 km/h (7.3%)

Type C – 4.0 km/h (6.5%).

- the 85th percentile speeds had reduced by:

Type A – 1.8 km/h (3.1%)

Type B – 5.5 km/h (10.1%)

Type C – 4.0 km/h (5.8%).

- the percentage of vehicles exceeding the speed limit had reduced from:

Type A – 22.4% to 12.9%

Type B – 36.1% to 9.4%

Type C – 56.3% to 34.8%.

- the percentage of vehicles exceeding the speed limit by more than 10 km/h had reduced from:

Type A – 3.8% to 1.7%

Type B – 4.3% to 0.7%

Type C – 14.3% to 6.6%.

- the percentage of vehicles exceeding the speed limit by more than 20 km/h had reduced from:

Type A – 0.3% to 0.1%

Type B – 0.4% to 0.0%

Type C – 1.6% to 0.6%.

3. Heavy vehicles in the school zones

Heavy vehicle speeds and speeding rates decreased across all treatment sites by the end of the 12 month evaluation period. This is consistent with the trends noted across all vehicles, although the speeds and speeding rates among heavy vehicles were lower than those for all vehicles.

Conclusions

The speed survey data reveal that the speed cameras had a pronounced effect on driver behaviour in terms of reduced speeding at school zones. Overall, reductions have been observed in traffic speeds and the percentage of vehicles exceeding the speed limit and these reductions have been maintained or improved after 12 months of speed camera operation.

Vehicle speeds and speeding rates on the lengths of road approaching the school zones with speed cameras (the 'approach lengths') also reduced, although the reductions were not as substantial, with speed reductions generally less than 10 per cent. In some cases however, the proportion of vehicles exceeding the speed limit in these approach lengths dropped by more than 30 per cent in both directions (that is, on both approaches to the school zone). These reductions take into account the activity at control sites and therefore can be attributed to the presence of the fixed digital speed cameras.

These speed reductions achieved on approaches to school zones suggest that drivers are indeed aware of the presence of the cameras and are slowing down in readiness for the school zone in areas where they would not have slowed down in the past.

Heavy vehicle 85th percentile speeds have reduced to below the 40 km/h speed limit at most sites and the proportions of heavy vehicles exceeding the speed limit have dropped substantially. Note however, that control site heavy vehicle figures have not been compared with treatment site figures.

I Introduction

I.1 Background

The NSW Roads and Traffic Authority (RTA) reports that in 2003 speed was a factor in 36 per cent of all fatal crashes, in 41 per cent of fatal crashes on country roads and in 29 per cent on metropolitan roads².

In an endeavour to improve road safety outside schools by lowering vehicle speeds, the NSW Roads and Traffic Authority (RTA) began installing 40 km/h regulatory school zone speed limits in 1992. In 2002, a large number of additional installations were completed to provide school zones at all primary schools. To also encourage increased compliance with this lower limit, the RTA undertook a trial of the operation of fixed speed cameras in conjunction with the 40 km/h school speed limit. Over 7,200 RTA warning letters were sent out to speeding offenders detected in 40 km/h school zone periods over three weeks prior to the 10 school zone speed cameras commencing full-time operations in July 2003. No infringements were issued while each new school zone speed camera was being tested and monitored.

In December 2002, the RTA commissioned ARRB Group Ltd to conduct an evaluation of fixed, digital speed cameras in 40 km/h school speed zones.

I.2 Objective

The objective of the evaluation was to determine the impact on speed of fixed speed cameras at a sample of 40 km/h school speed zones in New South Wales. The impact of the devices was measured in terms of the changes in driver speed behaviour (that is, proportion of motorists speeding above pre-determined thresholds, mean speeds and 85th percentile speeds) occurring at the school zones and on both approaches to each school speed zone.

I.3 Scope

Speed surveys were conducted at 10 school speed zones over at least 7 days. During this period up to 5 days of speed survey data were collected for analysis during the school commence times of 8.00am to 9.30am, and school end periods of 2.30pm to 4.00pm. With the exception of one school zone that operated along a 50 km/h road, all of the other school zones were located on roads speed zoned at 60 km/h.

To more accurately determine the effects of the fixed digital speed cameras within school speed zones, speed surveys were also conducted on a similar group of 8 school speed zones which, during the course of the study, operated without speed cameras. The changes in speed data collected at the control sites enabled the changes detected at the camera sites to be calibrated to account for changes that may have resulted from 'other' factors. Section 1.4 of this report provides more detail about the control sites.

Speed surveys were carried out at each of the fixed digital speed camera and control sites:

² NSW Roads and Traffic Authority crash statistics, 2004

- Just before installation of the fixed digital speed cameras during November and December 2002.
- Just after the commencement of operation³ of the fixed digital camera sites during July and August 2003
- Three months following the commencement of operation of the fixed digital speed cameras during October and November 2003.
- Twelve months following the commencement of operation of the fixed digital speed cameras during August 2004.

1.4 Method

1.4.1 Fixed digital speed camera sites

1.4.1.1 Collection of speed data

- a) Speed surveys were conducted at three locations for each of 10 sites where fixed, digital speed cameras had been installed. They were carried out for each site as illustrated in Figure 1, which shows the layout of a typical camera location and the points and directions in which speed data were collected. It should be noted that each of fixed digital speed camera was selected by the RTA in accordance with its criteria. The compass directions shown in the example are for illustrative purposes only; not all sites ran east-west.

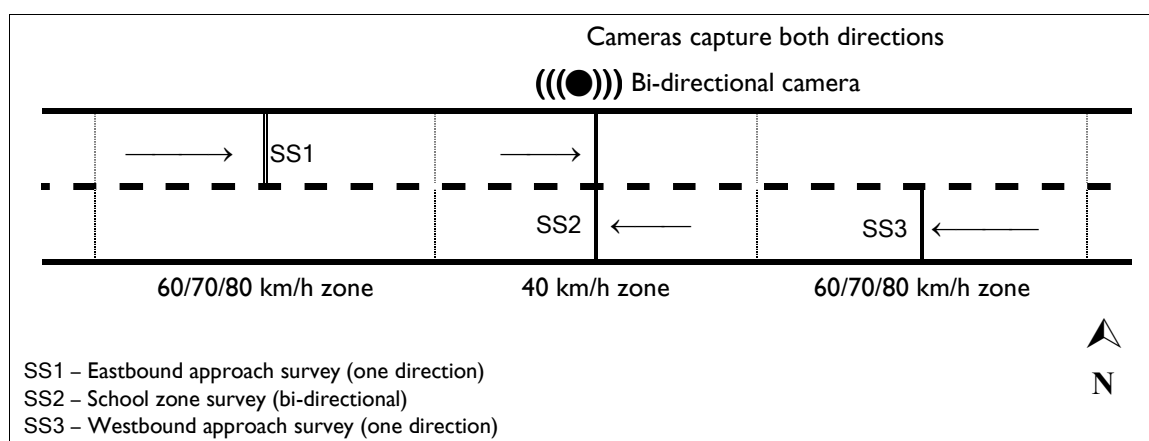


Figure 1: Layout of speed surveys

- b) To account for any changes in speeds that may have occurred for other reasons (eg. seasonal changes, changed weather conditions, etc) speed data were also collected in school zones where there was no camera. To ensure that changes that may have occurred due to 'other' reasons were measured as accurately as possible, control sites had to be matched as closely as possible in terms of geometric, environmental and operational characteristics to the speed camera sites. Each of the control sites was also selected by the RTA.

³ The cameras had been switched on before this but were only issuing warning notices. In this report, when cameras are referred to as operational it means that they were issuing infringement notices.

Speed surveys were conducted at three locations in each of the eight (8) matched control sites (for two of the camera sites, no suitable control sites were able to be found):

- One location in the 40 km/h school zone (both directions).
- One approach just outside the school zone on one side.
- One location just outside the school zone on the opposite approach.

1.4.1.2 Collection method and equipment

The speed surveys were conducted using three-second headways. This means that only vehicles that were travelling at least three seconds behind the previous vehicle were included in the speed figures. Restricting the surveys in this way ensures that the speed figures returned are 'free' speeds; that is, the speeds at which vehicles would travel if there were no other vehicles restricting their travel.

Speed survey data were collected over continuous periods of at least seven days, 24 hours a day. However, as this evaluation was only concerned with traffic behaviour during the school speed zone hours of 8:00-9:30am and 2:30-4:00pm on school days, those are the only time periods for which the speed surveys have been analysed.

Data for the baseline and immediate follow-up surveys were collected using RTA Trafficorder Mark 2 devices. Data for the three-month and 12-month follow-up surveys were collected using Metrocount devices, and their output was converted to Trafficorder format before analysis. This method ensured that the outputs from the two different types of devices matched the specification set by the RTA.

1.4.1.3 Collection dates of speed data

Table I below summarises the periods during which speed surveys were conducted (at both the speed camera sites and their matched control sites). It should be noted that the speed cameras were installed and commissioned during February 2003 and began issuing infringements on 15 July 2003.

Due to a delay in the commencement of operation of the cameras, the three-month follow-up surveys were similarly delayed. For this reason, additional surveys were conducted at camera sites immediately after the cameras began issuing infringement notices. During the time between the baseline surveys and the commencement of full camera operation (that is, before the immediate follow-up surveys), warning letters were sent to any drivers caught exceeding the speed limit. Infringement notices were not sent until all 10 cameras were ready for full operation.

Table I: Speed data collection dates

Term 4, 2002	Term 2, 2003	Term 4, 2003	Term 3, 2004
November/December 2002 Pre speed camera - installation	July/August 2003 Additional survey just after cameras became operational	October/November 2003 (three-month follow-up)	August 2004 (12-month follow-up)

1.4.1.4 Analysis of speed data

Descriptive statistical analysis was used when comparing 'before' and 'after' speed surveys to give an indication of the impact of the fixed digital speed cameras on vehicle speeds within the school speed zones.

The speed survey data analysis included:

- Mean speed (the average speed of all vehicles).
- 85th percentile speed (the speed at or below which 85% of vehicles were travelling).
- Standard deviation of speed (the average margin by which the speeds deviate from the mean).
- Percentage of vehicles exceeding the speed limit.
- Percentage of vehicles exceeding the speed limit by more than 10 km/h.
- Percentage of vehicles exceeding the speed limit by more than 20 km/h.
- Percentage of vehicles exceeding the speed limit by more than 30 km/h.

The analysis for heavy vehicles includes:

- Percentage of heavy vehicles in the survey.
- Mean speed of heavy vehicles.
- 85th percentile speed of heavy vehicles.
- Standard deviation of speed.
- Percentage of heavy vehicles exceeding the speed limit.
- Percentage of heavy vehicles exceeding the speed limit by more than 10 km/h.
- Percentage of heavy vehicles exceeding the speed limit by more than 20 km/h.
- Percentage of heavy vehicles exceeding the speed limit by more than 30 km/h.

2 Speed survey analysis

The assessment of the impact of the fixed digital speed cameras on observed speeds at 40 km/h school zones was based on the changes observed in each of the speed characteristics from the pre-installation surveys, the immediate follow-up surveys (camera sites and their controls), the three-month follow-up surveys and the 12-month follow-up surveys.

It should be noted that in this analysis, the speed limit was 40 km/h for all observations carried out during the times of operation of the school speed limits. The various sites have speed limits of 50 or 60 km/h at other times of the day, but those times are not the subject of this evaluation.

The analysis has been completed in two ways for all vehicles:

1. Combined data by speed zone (that is, organised into groups according to non-school zone-time speed zone) for pre-installation and three-month post-installation surveys. This includes speed measurements in the approach lengths.
2. Comparison of speed characteristics by individual sites in the school speed zone only (i.e. not in the approach lengths).

These analyses are expected to be most revealing about the influence of the speed cameras on speeds at and in the vicinity of the camera sites.

In addition to the analysis of speed trends for all vehicles presented in Section 2.2, Section 2.3 presents recorded speed and speeding rate values for heavy vehicles. These results are not subjected to a treatment-control analysis but are presented to show how the speed profile of heavy vehicles, as distinct from all vehicles, has changed over the evaluation period.

2.1 Interpreting speed surveys

Figure 2 depicts two hypothetical distributions of vehicle speed. The solid line shows the original speed distribution whilst the dashed line represents the speed distribution following the introduction of a successful countermeasure to speeding. However it should be noted that the example depicted is exaggerated. The distinctions between the two distributions are likely to be more subtle than the changes depicted.

$\bar{x}_{0,1}$ = mean speed (km/h)

$P_{0,1}^{85}$ = 85th percentile speed (km/h)

$SD_{0,1}$ = standard deviation (km/h)

Note: 0 = baseline data, prior to the introduction of the countermeasure (solid line);
1 = post-installation introduction of countermeasure (dashed line).

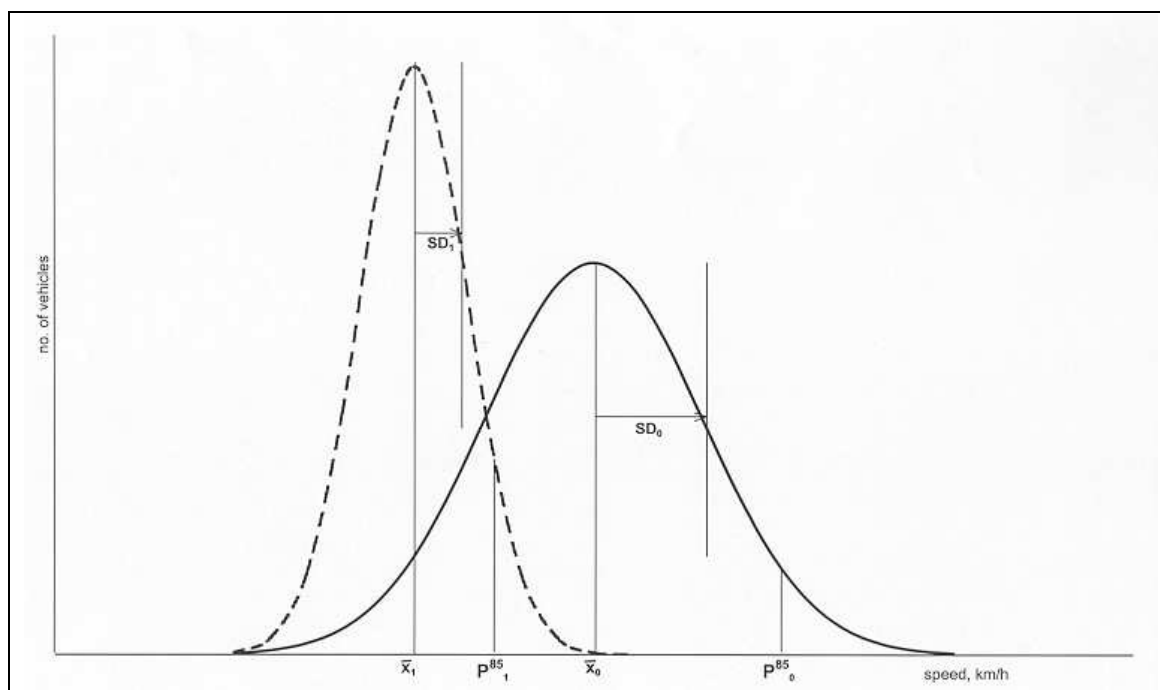


Figure 2: Hypothetical distributions of speed

2.2 Results: trends in speed characteristics at the school zone

2.2.1 Recorded data by site within the school speed zone

Tables 2 to 4 show the recorded speed results for all vehicles within the 40 km/h school speed zone across all sites. These are the figures from which the charts in Figures 3, 5, 7, 9, 11 and 13 are created.

These tables show that speeds and speeding rates decreased across all treatment sites by the end of the 12 month evaluation.

The percentages of vehicles exceeding the speed limit increased substantially across five treatment sites at the three-month surveys, before dropping again at the 12-month surveys. These spikes were accompanied by similar changes at two of the treatment sites' matching control sites (Kellyville PS and St John Vianney's). Taken in isolation (that is, without

considering control site changes), these spikes in speeding rates at treatment sites could suggest that the effect of the speed cameras reduces slightly in the first few months after they are installed. However, for two of the five sites the spikes in speeding rates were accompanied by similar spikes at control sites, suggesting that some other local influence was altering vehicle speeds, at least at those two sites. As the spikes only occurred at five of the 10 treatment sites, it seems likely that local conditions could have caused the effect at all five of the sites where it occurred.

A similar effect appeared across three of the treatment sites for the percentage of vehicles exceeding the speed limit by more than 20 km/h. In this case, two of the three corresponding control sites also showed a spike in the percentage exceeding the limit by more than 20 km/h. This strengthens the theory that local conditions are causing these spikes in speeding rates.

There was little change in the proportions of vehicles exceeding the speed limit by more than 30 km/h, but these proportions were very small at the baseline surveys, making most changes less obvious.

Control site data are presented in the lower section of each table. Section 2.2.2 uses these control data to discuss whether the speed and speeding rate reductions can be attributed to the fixed digital speed cameras.

Note that all sites had a 60 km/h speed limit outside school zone times, except Middle Harbour Public School, which had a 50 km/h limit.

Table 2: Recorded mean and 85th percentile speeds for all speed camera sites, all vehicles, in the school zone

School	Direction	Mean speed (km/h)				85 th percentile speed (km/h)			
		Baseline	Immed.	3-month	12-month	Baseline	Immed.	3-month	12-month
Treatment sites									
Middle Harbour PS**	N	45.5	39.8	40.0	38.8	52.5	44.5	45.5	43.5
	S	40.6	36.4	34.9	35.3	49.0	43.5	42.5	40.5
St Patrick's PS	N	46.7	35.9	42.3	33.8	59.0	45.0	53.5	40.0
	S	53.3	38.2	41.2	34.6	64.5	47.0	51.5	40.0
St Catherine Laboure PS	E	41.3	35.5	33.3	33.9	52.0	44.0	41.3	42.0
	W	46.6	38.6	37.5	36.7	55.0	44.0	42.5	41.5
Epping West PS	E	51.6	37.8	39.0	36.0	63.5	45.0	50.0	41.5
	W	52.2	37.7	38.4	36.9	62.2	44.5	44.0	42.0
Illawarra Grammar*	N	51.8	36.4	37.9	35.4	60.5	40.5	46.5	40.0
	S	54.1	36.3	38.5	35.2	62.5	41.0	46.0	39.0
Fairy Meadow DS	E	48.2	34.7	36.5	33.4	58.0	39.5	43.0	38.0
	W	45.3	37.1	38.4	34.3	53.5	42.5	45.0	39.0
Woy Woy PS	E	44.0	41.5	36.7	34.2	52.0	53.0	42.5	39.0
	W	42.6	41.9	34.8	34.7	51.0	53.0	40.0	39.5
Woy Woy South PS	N	45.0	39.7	39.8	34.7	55.0	51.0	51.0	40.5
	S	46.2	41.6	42.3	36.6	54.5	52.5	52.0	41.0
Our Lady of the Rosary PS	N	48.6	42.1	38.7	36.6	56.5	52.0	45.5	41.0
	S	47.8	43.1	41.1	39.7	55.0	52.0	47.0	44.5
Ourimbah PS	N	52.4	42.2	39.8	35.8	61.5	53.5	50.0	40.0
	S	45.4	40.4	38.5	29.9	59.5	53.5	49.5	36.0
Control sites									
Lindfield PS (control for St Patrick's PS)		53.1	52.8	53.2	50.7	62.3	60.5	61.8	59.0
Croydon Park PS (control for St Catherine Laboure PS)		42.4	41.2	39.1	39.9	53.5	52.3	50.5	50.8
Kellyville PS (control for Epping West PS)		54.9	49.7	51.0	50.4	65.8	61.0	62.0	61.8
St John Vianney's (control for Fairy Meadow DS)		44.5	43.3	44.1	40.8	55.0	53.8	42.1	50.5
Adamstown PS (control for Woy Woy PS)		47.5	48.1	46.3	45.5	56.0	57.1	55.5	55.0
Charlestown East PS (control for Woy Woy South PS)		52.5	54.1	51.8	49.3	60.5	63.0	60.5	58.5
Niagara Park PS (control for Our Lady of the Rosary PS)		44.6	42.2	42.3	42.7	54.5	50.5	51.5	50.8
Cardiff PS (control for Ourimbah PS)		49.7	51.9	46.5	46.4	60.5	62.0	58.0	57.8

* No control schools were available for Middle Harbour Public School and Illawarra Grammar School

+ Middle Harbour PS was the only site with a 50 km/h non-school hours limit. All other sites had a 60 km/h limit.

Table 3: Recorded percentages of vehicles travelling over the speed limit and more than 10 km/h over the limit for all speed camera sites, all vehicles, in the school zone

School	Direction	% travelling above speed limit				% more than 10 km/h over limit			
		Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'	Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'
Treatment sites									
Middle Harbour PS**	N	75.6	38.0	41.3	29.2	23.0	4.0	4.5	3.5
	S	54.6	26.1	21.9	13.8	10.2	3.3	2.0	1.2
St Patrick's PS	N	69.0	26.9	56.0	17.7	43.0	8.5	25.1	4.2
	S	85.8	29.7	48.4	13.9	65.0	10.8	20.9	3.8
St Catherine Laboure PS	E	51.4	23.1	18.0	18.9	20.3	4.6	3.2	3.5
	W	76.2	30.7	24.9	18.7	26.3	3.7	2.6	1.7
Epping West PS	E	81.5	25.1	31.4	18.0	59.9	7.7	14.3	4.7
	W	88.3	24.9	27.5	20.0	58.7	5.8	6.9	4.8
Illawarra Grammar**	N	88.3	14.6	29.1	13.2	58.5	3.1	9.5	2.3
	S	94.7	16.0	29.5	10.4	65.7	3.5	8.7	1.7
Fairy Meadow DS	E	80.4	10.7	23.4	6.0	49.6	1.0	5.1	0.2
	W	72.4	22.1	30.9	9.9	25.6	2.7	5.1	0.4
Woy Woy PS	E	68.2	45.8	22.3	10.0	20.1	20.9	4.2	1.3
	W	61.0	47.1	14.4	11.7	17.7	20.2	1.6	1.7
Woy Woy South PS	N	67.5	38.9	39.6	14.3	31.4	15.5	16.0	2.5
	S	75.9	43.1	50.6	15.9	29.6	19.9	19.3	1.9
Our Lady of the Rosary PS	N	83.6	46.7	29.9	16.9	42.0	18.7	6.1	2.8
	S	84.9	55.5	48.2	40.4	36.2	18.6	7.8	3.6
Ourimbah PS	N	92.2	45.7	36.7	14.8	57.5	21.1	13.9	1.9
	S	66.4	45.9	40.9	6.7	41.5	23.6	13.4	1.0
Control sites									
Lindfield PS (control for St Patrick's PS)		90.6	93.4	92.8	90.4	65.0	62.7	63.4	51.5
Croydon Park PS (control for St Catherine Laboure PS)		57.3	52.3	45.9	48.7	22.9	19.8	16.7	17.8
Kellyville PS (control for Epping West PS)		90.9	80.1	86.7	85.9	66.7	43.9	48.5	44.5
St John Vianney's (control for Fairy Meadow DS)		64.8	59.9	63.0	48.6	28.4	23.4	26.6	14.6
Adamstown PS (control for Woy Woy PS)		78.5	79.7	75.1	72.1	38.0	41.2	33.9	29.0
Charlestown East PS (control for Woy Woy South PS)		92.7	93.7	90.5	86.2	60.0	65.4	57.1	42.8
Niagara Park PS (control for Our Lady of the Rosary PS)		66.2	56.2	57.0	60.5	25.4	15.7	17.7	16.5
Cardiff PS (control for Ourimbah PS)		78.8	84.8	70.8	71.1	49.6	58.9	9.6	34.1

* No control schools were available for Middle Harbour Public School and Illawarra Grammar School

+ Middle Harbour PS was the only site with a 50 km/h non-school hours limit. All other sites had a 60 km/h limit.

Table 4: Recorded percentages of vehicles more than 20 and 30 km/h over the limit for all speed camera sites, all vehicles, in the school zone

School	Direction	% more than 20 km/h over limit				% more than 30 km/h over limit			
		Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'	Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'
Treatment sites									
Middle Harbour PS ⁺	N	2.5	0.2	0.2	0.2	0.2	0.0	0.0	0.0
	S	1.0	0.2	0.1	0.1	0.1	0.0	0.0	0.0
St Patrick's PS	N	13.3	1.5	3.3	0.7	2.3	0.1	0.2	0.1
	S	27.0	2.2	3.4	0.6	5.5	0.3	0.3	0.0
St Catherine Laboure PS	E	3.1	0.5	0.2	0.2	0.3	0.0	0.0	0.0
	W	7.1	0.6	0.3	0.2	0.8	0.0	0.0	0.0
Epping West PS	E	23.9	1.2	1.7	0.5	4.5	0.1	0.1	0.0
	W	19.7	0.5	0.8	0.5	2.3	0.0	0.0	0.0
Illawarra Grammar	N	15.7	0.4	0.7	0.2	1.7	0.0	0.0	0.0
	S	22.0	0.4	0.7	0.2	2.9	0.0	0.0	0.1
Fairy Meadow DS	E	5.6	0.1	0.2	0.0	0.2	0.0	0.0	0.0
	W	2.2	0.1	0.1	0.0	0.1	0.0	0.0	0.0
Woy Woy PS	E	0.6	1.3	0.2	0.1	0.0	0.0	0.0	0.0
	W	0.6	2.2	0.1	0.1	0.0	0.1	0.0	0.0
Woy Woy South PS	N	4.2	0.2	0.7	0.1	0.2	0.0	0.0	0.0
	S	2.7	1.5	0.7	0.1	0.1	0.0	0.0	0.0
Our Lady of the Rosary PS	N	4.9	1.2	0.2	0.1	0.2	0.1	0.0	0.0
	S	3.7	1.0	0.4	0.3	0.2	0.1	0.0	0.0
Ourimbah PS	N	16.9	2.8	0.8	0.1	1.5	0.1	0.0	0.0
	S	12.3	1.8	0.3	0.0	1.2	0.1	0.0	0.0
Control sites									
Lindfield PS (control for St Patrick's PS)		19.9	15.4	19.8	11.6	2.7	1.9	2.6	1.0
Croydon Park PS (control for St Catherine Laboure PS)		4.4	3.8	2.7	2.9	0.7	0.6	0.3	0.3
Kellyville PS (control for Epping West PS)		31.0	16.3	19.4	17.8	6.8	3.1	3.5	3.8
St John Vianney's (control for Fairy Meadow DS)		4.7	3.8	5.2	2.2	0.7	0.5	0.5	0.2
Adamstown PS (control for Woy Woy PS)		5.4	6.6	4.8	4.1	0.4	0.4	0.3	0.4
Charlestown East PS (control for Woy Woy South PS)		16.0	23.4	16.0	10.1	1.7	3.0	1.5	0.8
Niagara Park PS (control for Our Lady of the Rosary PS)		4.6	1.7	2.7	2.7	0.3	0.1	0.1	0.1
Cardiff PS (control for Ourimbah PS)		15.3	19.7	9.6	9.6	2.5	2.3	0.9	1.0

* No control schools were available for Middle Harbour Public School and Illawarra Grammar School

+ Middle Harbour PS was the only site with a 50 km/h non-school hours limit. All other sites had a 60 km/h limit.

2.2.2 Overall comparisons by speed zone within the 40 km/h speed zone – all vehicles

Tables 5 to 7 describe the speed characteristics during each series of speed surveys for all vehicles across all camera sites. Data from both travel directions at the camera sites have been combined as the cameras operated in both directions and to separate travel directions in these tables where various sites' records are combined would not have been meaningful.

It should be noted that the number of sites in each speed zone varies:

- 50 km/h – 1 camera site (no control site).
- 60 km/h – 9 camera sites and 8 control sites

Table 5 contains data from the school speed zones that are zoned 60 km/h outside school zone hours and which had control sites. Table 6 presents data from the site that is zoned 50 km/h outside school zone hours and has no control site. Table 7 presents data from the site that is zoned 60 km/h outside school zone hours and has no control site.

There was an overall reduction in mean speeds, 85th percentile speeds and the percentage of vehicles exceeding the speed limit across all speed zones between the baseline and follow-up speed surveys. These reductions are associated with the speed camera treatments and Section 2.2.3, below, describes how the association was determined.

2.2.3 Application of control ratios

For each of the analysis methods listed above, control data have been used to create control ratios. The control ratios are applied to the baseline data from each controlled site to generate 'expected' values for various parameters at follow-up surveys. The *actual* follow-up data from controlled sites are then compared with *expected* values to determine how much, if any, change in the parameter can be attributed to the presence of the treatment.

For example, if Site A recorded a baseline mean speed figure of 50 km/h and a first follow-up figure of 45 km/h, this would be a reduction of 10 per cent if control data were ignored. However, if Site A's corresponding control site recorded a drop from 52 km/h to 48 km/h (8 per cent) in the same time, a 'control ratio' of 92 per cent (100 minus 8) would then be allocated to Site A. This is because if the speed camera had not been installed at Site A, then, all other factors being equal, the speed at the follow-up survey could be expected to be 92 per cent of the speed at the baseline survey.

Applying the control ratio of 92 per cent to Site A's baseline of 50 km/h produces an expected follow-up figure of 46 km/h. As Site A's actual follow-up figure was 45 km/h, the reduction in speed attributable to the speed camera is only 1 km/h (46 minus 45), which equates to a reduction of 2.2 per cent.

Table 5: Speed characteristics for the eight speed camera sites with controls (40 km/h in school zone times, 60 km/h other times)* – all vehicles, in the school zones

Speed characteristics	Baseline 'before' (km/h)	Just 'after'					3-month 'after'					12-month 'after'				
	Control ratio	Expected	Actual	Diff.	%	Control ratio	Expected	Actual	Diff.	%	Control ratio	Expected	Actual	Diff.	%	
	①	②	③=①×②	④	⑤=④-③	⑥/③×100	②	③=①×②	④	⑤=④-③	⑥/③×100	②	③=①×②	④	⑤=④-③	⑥/③×100
Mean speed, \bar{x} (km/h)	47.4	0.98	46.7	39.0	-7.7	-16.4	0.96	45.6	38.6	-7.1	-15.5	0.94	44.6	34.9	-9.6	-21.6
85 th percentile speed, P ⁸⁵ (km/h)	56.9	0.98	55.9	47.8	-8.2	-14.6	0.94	53.7	46.7	-7.0	-13.1	0.95	54.0	40.1	-13.9	-25.7
Percentage above speed limit	76.1	0.97	73.7	33.9	-39.8	-54.0	0.94	71.5	33.9	-37.5	-52.5	0.91	69.2	15.0	-54.3	-78.4
Percentage more than 10 km/h above speed limit	39.4	0.93	36.6	12.3	-24.4	-66.5	0.77	30.3	10.2	-20.1	-66.4	0.70	27.7	2.1	-25.6	-92.3
Percentage more than 20 km/h above speed limit	8.9	0.90	7.9	1.1	-6.8	-85.9	0.79	7.0	0.8	-6.3	-89.1	0.60	5.3	0.2	-5.2	-96.5
Percentage more than 30 km/h above speed limit	1.1	0.76	0.8	0.1	-0.8	-93.4	0.62	0.7	0.0	-0.6	-93.5	0.48	0.5	0.0	-0.5	-96.5

* All of the sites with controls are zoned 60 km/h outside school zone times

Table 6: Speed characteristics for the single 40 km/h school zone speed camera site, without a control site, that is zoned 50 km/h outside school zone hours – all vehicles, in the school zone

Speed characteristics	Baseline 'before' (km/h)	Just 'after'	3-month 'after'	12-month 'after'	Baseline - just 'after'		Baseline – 3-month 'after'		Baseline – 12-month 'after'	
					km/h	%	km/h	%	km/h	%
	①	②	③	④	⑤=②-①	⑥=⑤/①×100	⑦=③-①	⑧=⑦/①×100	⑨=④-①	⑩/①×100
Mean speed, \bar{x} (km/h)	43.1	38.1	37.4	37.0	-5.0	-11.5	-5.6	-13.1	-6.0	-14.0
85 th percentile speed, P ⁸⁵ (km/h)	50.8	44.0	44.0	42.0	-6.8	-13.3	-6.8	-13.3	-8.8	-17.2
Percentage above speed limit	65.1	32.1	31.6	21.5	-33.0	-50.7	-33.5	-51.4	-43.6	-66.9
Percentage more than 10 km/h above speed limit	16.6	3.7	3.3	2.4	-12.9	-77.9	-13.3	-80.3	-14.2	-85.7
Percentage more than 20 km/h above speed limit	1.8	0.2	0.2	0.2	-1.6	-87.1	-1.6	-90.5	-1.6	-91.6
Percentage more than 30 km/h above speed limit	0.1	0.0	0.0	0.0	-0.1	-96.6	-0.1	-88.1	-0.1	-94.9

Table 7: Speed characteristics for the single 40 km/h school zone speed camera site, without a control site, that is zoned 60 km/h outside school zone hours – all vehicles, in the school zone

Speed characteristics	Baseline 'before' (km/h)	Just 'after'	3-month 'after'	12-month 'after'	Baseline - just 'after'		Baseline – 3-month 'after'		Baseline – 12-month 'after'	
					km/h	%	km/h	%	km/h	%
	①	②	③	④	⑤=②-①	⑤/①×100	⑦=③-①	⑦/①×100	⑨=④-①	⑨/①×100
Mean speed, \bar{x} (km/h)	51.9	37.8	38.7	36.4	-14.1	-27.2	-13.2	-25.4	-15.5	-29.8
85 th percentile speed, P ⁸⁵ (km/h)	62.9	44.8	47.0	41.8	-18.1	-28.8	-15.9	-25.2	-21.1	-33.6
Percentage above speed limit	84.9	25.0	29.5	19.0	-59.9	-70.5	-55.4	-65.3	-65.9	-77.6
Percentage more than 10 km/h above speed limit	59.3	6.8	10.6	4.8	-52.6	-88.6	-48.7	-82.1	-54.6	-92.0
Percentage more than 20 km/h above speed limit	21.8	0.8	1.3	0.5	-21.0	-96.2	-20.5	-94.2	-21.3	-97.8
Percentage more than 30 km/h above speed limit	3.4	0.0	0.1	0.0	-3.4	-98.9	-3.3	-97.9	-3.4	-99.5

2.2.4 Overall comparisons of speed characteristics within the 40 km/h school speed zone for each school

Figures 3 to 14 depict the following characteristics of speed for individual school zones:

- Mean speed, \bar{x} (km/h).
- 85th percentile speed, P^{85} (km/h).
- Percentage of vehicles travelling above the speed limit (%).
- Percentage of vehicles travelling more than 10 km/h above the speed limit (%).
- Percentage of vehicles travelling more than 20 km/h above the speed limit (%).
- Percentage of vehicles travelling more than 30 km/h above the speed limit (%).

These data are presented for both travel directions in the school zones as the cameras operated in both directions.

Comparison with expected values

In addition to each chart showing recorded results for camera sites, a second chart for each speed characteristic shows a comparison between expected and actual follow-up figures for the sites, based on ratios calculated from control sites. A description of how the expected and actual figures were calculated is presented in Section 2.2.3.

The immediate follow-up data from the speed camera sites show that the speed cameras were having a noticeable effect on driver behaviour. The three-month follow-up data showed a number of sites' speeds beginning to increase, although not approaching baseline values. Data from the 12-month follow-up surveys indicated that declines in speeds and speeding rates resumed or continued at most sites.

2.2.4.1 Mean speed (km/h)

The majority of camera sites (Figure 3) showed reductions of at least 5 km/h between the pre-installation and immediate follow-up surveys. These changes occurred even though the cameras were not generating infringement notices, but were triggering warning letters for some of the time between the surveys. Half of the sites experienced further reductions between the immediate and three-month follow-up surveys. At every site other than Middle Harbour PS southbound and St Catherine Laboure eastbound, the 12-month mean speed figures were lower than those for every other survey period.

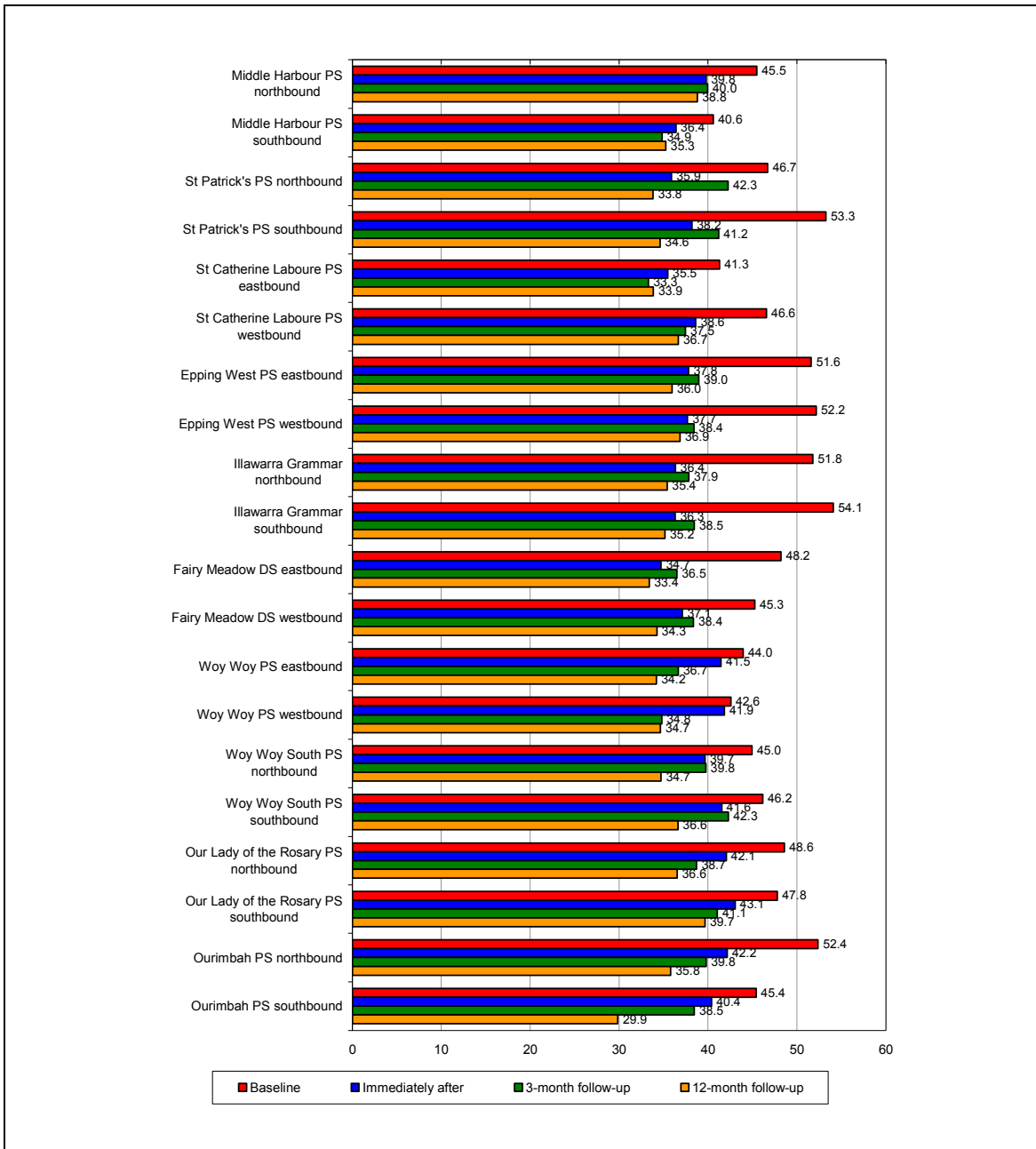


Figure 3: Mean speeds (km/h) at speed camera sites

Figure 4 shows differences between expected and actual mean speeds at all sites that have controls. The immediate follow-up, three-month follow-up and 12-month follow-up data for speed camera sites are compared with expected values.

These results indicate that all of the speed camera sites experienced reductions in mean speed, with four sites achieving speeds (in at least one direction) 20 per cent lower than expected at the immediate follow-up surveys. After the three-month follow-up surveys some of the sites' speeds began to rise but all remained below baseline figures. The 12-month follow-up surveys showed further reductions at three school zones, and all sites achieved mean speeds substantially lower than their baseline figures.

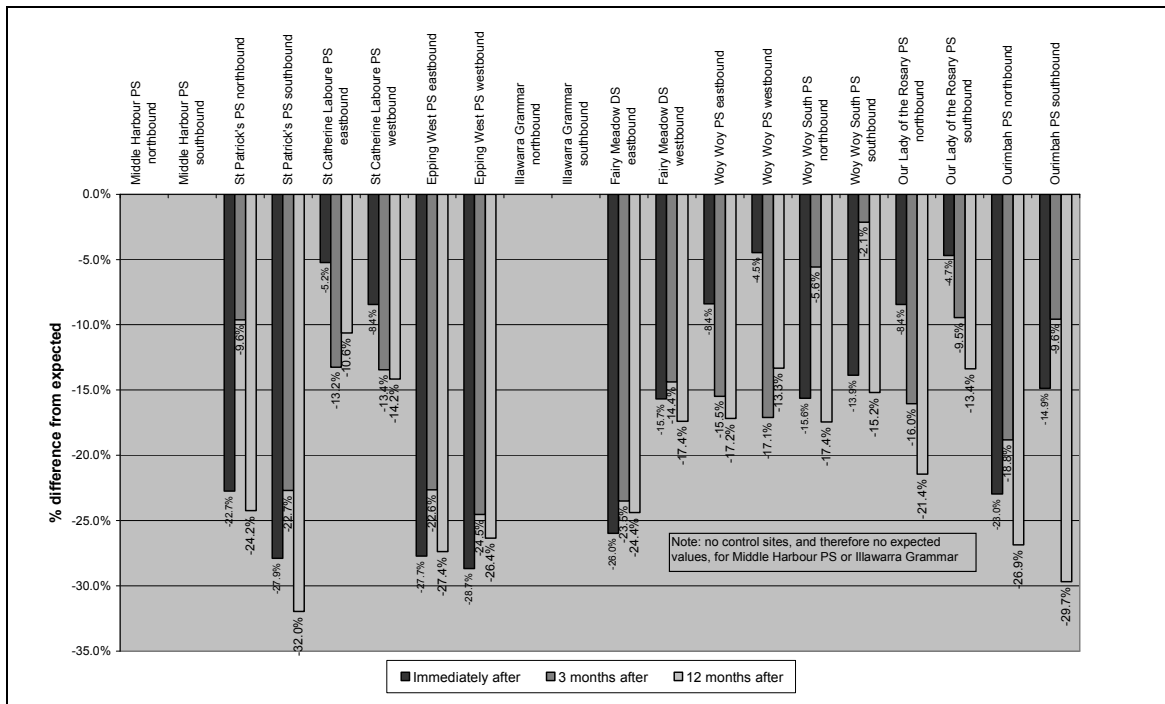


Figure 4: Difference between expected and actual mean speeds at treatment sites

2.2.4.2 85th percentile speed (km/h)

All but one site showed a decrease in 85th percentile speed between baseline and immediate follow-up surveys (Figure 5). One site (Woy Woy Public School) showed a slight increase in 85th percentile speed at the immediate follow-up but this was redressed at the three-month point. Of the other sites, Middle Harbour (northbound) and both directions for four other sites showed increases between the immediate and three-month follow-up surveys, but none exceeded the baseline figures. All sites other than St Catherine Laboure Primary School achieved their lowest 85th percentile speeds at the 12-month follow-up survey.

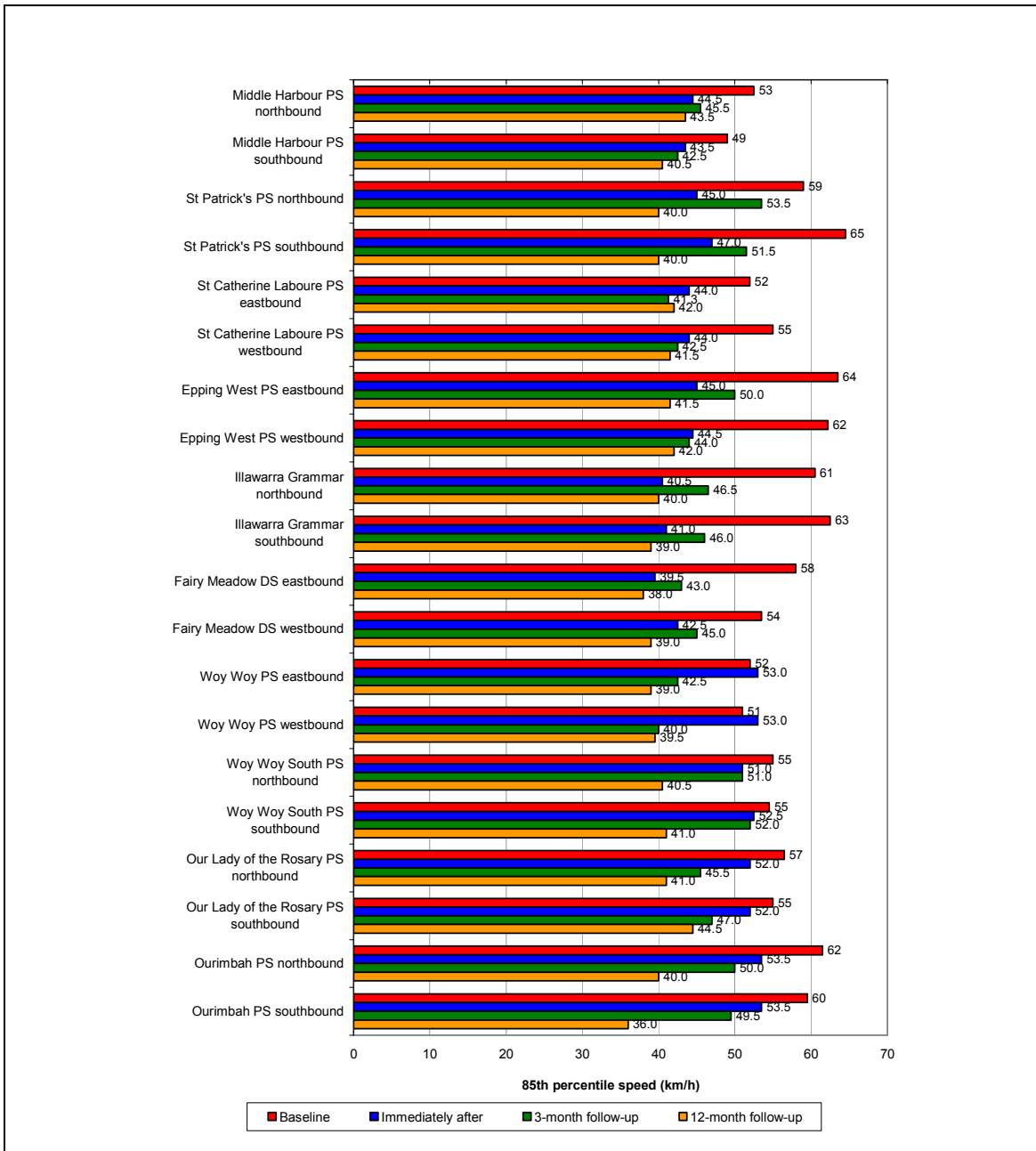


Figure 5: 85th percentile speeds (km/h) at speed camera sites

Figure 6 shows that six of the controlled speed camera sites (that is, those having controls) experienced substantial reductions in 85th percentile speed between baseline and immediate follow-up surveys, but one direction at each of two camera sites (Woy Woy and Our Lady of the Rosary) showed small increases (though the values at the three-month follow-up were reductions). Because these sites also exhibited reductions in mean speed it appears that some proportion of traffic previously travelling above the mean speed had increased their speed, while some previously below the mean speed reduced their speed. It is also apparent that reductions after three months were not as substantial as the immediate follow-up reductions. At three months there was an increase in one direction at Fairy Meadow while all other sites showed reductions. At 12 months, all but two sites (St Catherine Laboure and Fairy Meadow) achieved their lowest 85th percentile speeds in both directions, whereas St Catherine Laboure and Fairy Meadow did achieve their lowest 85th percentile speed in one direction. All sites showed 85th percentile speeds well below expected values.

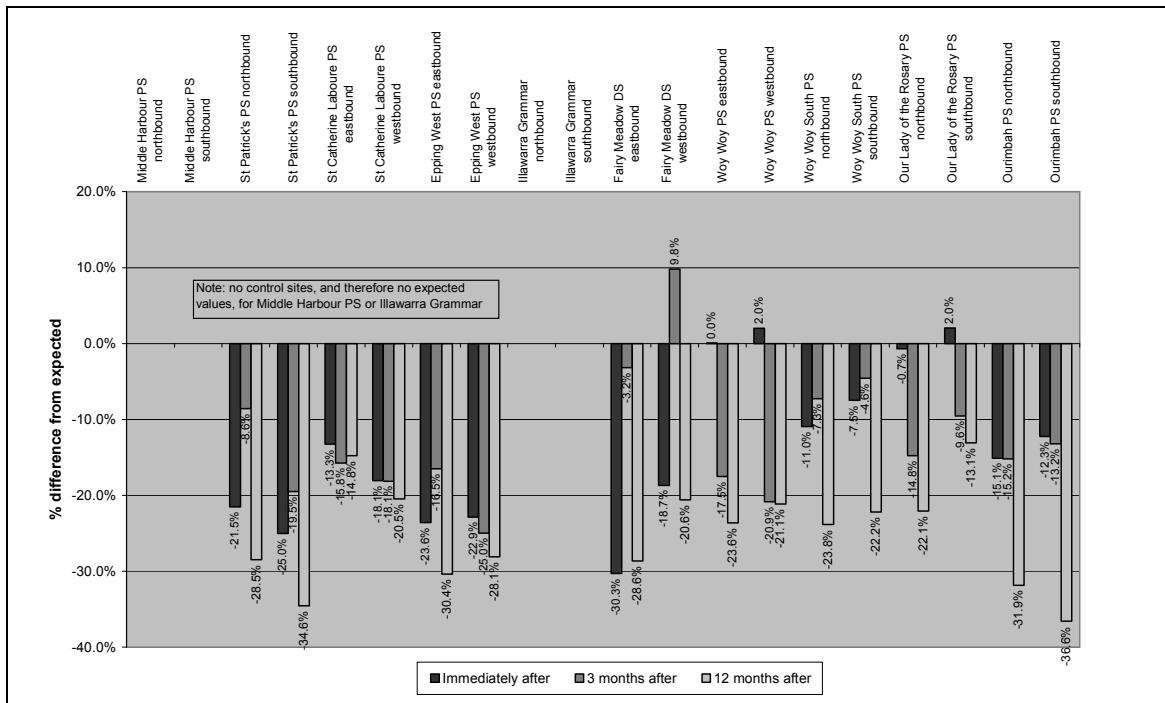


Figure 6: Difference between expected and actual 85th percentile speeds at treatment sites

2.2.4.3 Percentage of vehicles travelling above the speed limit

Considerable reductions in the proportion of vehicles exceeding the speed limit were recorded at all of the speed camera sites immediately after the cameras were commissioned (see Figure 7). Four sites' rates continued to reduce in both directions at the three-month follow-up, with one other site (Middle Harbour) reducing in the southbound direction only. Substantial further reductions were also found at the 12-month follow-up for all sites, although St Catherine Laboure increased slightly in the eastbound direction.

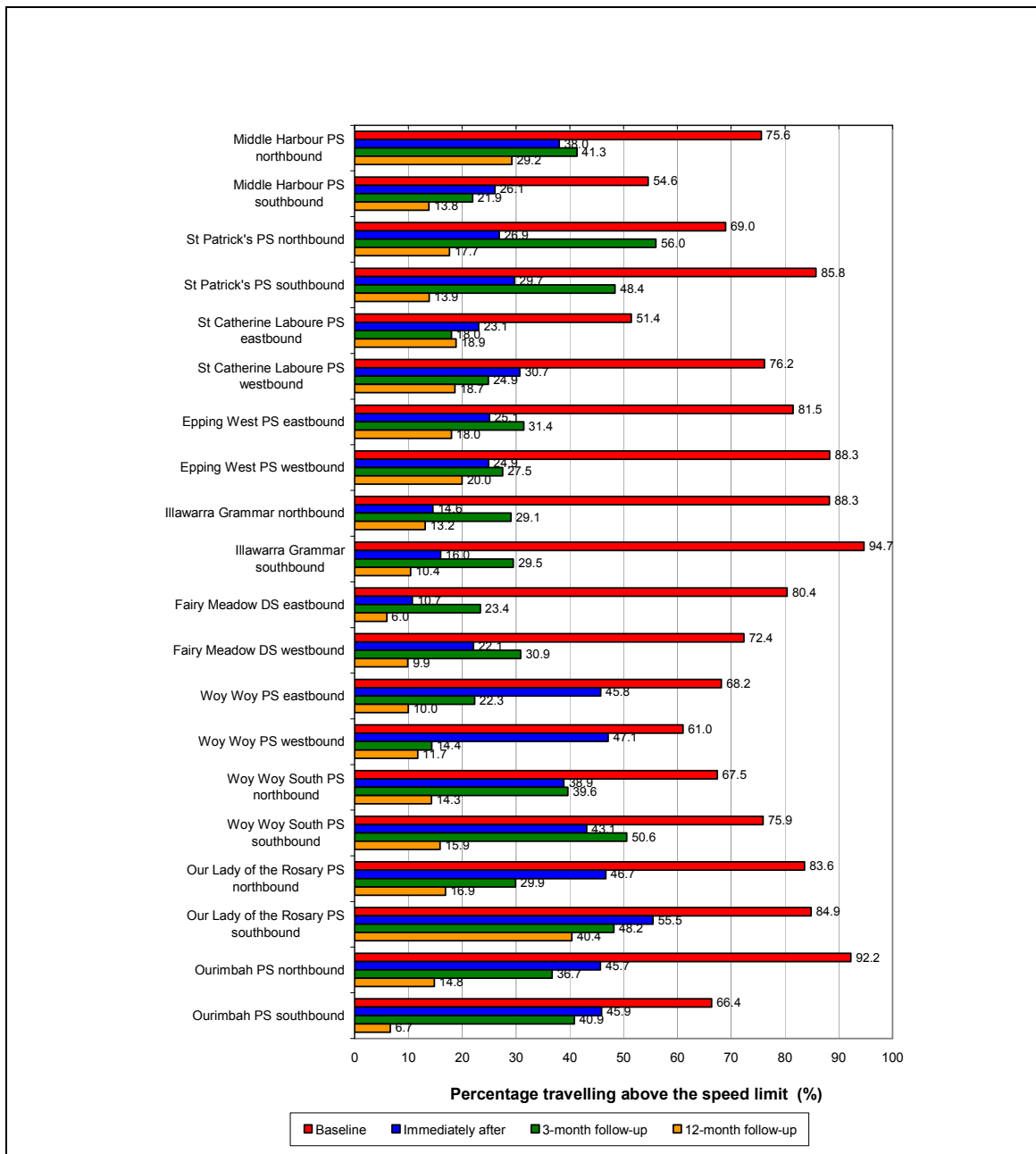


Figure 7: Percentage of vehicles travelling above the speed limit at camera sites

All of the controlled speed camera sites showed large reductions from expected values in the immediate follow-up proportion of vehicles exceeding the speed limit due to the influence of the cameras (Figure 8). The largest change was an 86 per cent reduction eastbound at the Fairy Meadow Public School site. Three sites' reductions were improved upon in both directions at the three-month follow-up surveys, while four sites showed an increase in both directions. After 12 months, all sites showed more than 48 per cent reductions from the expected speeding rates.

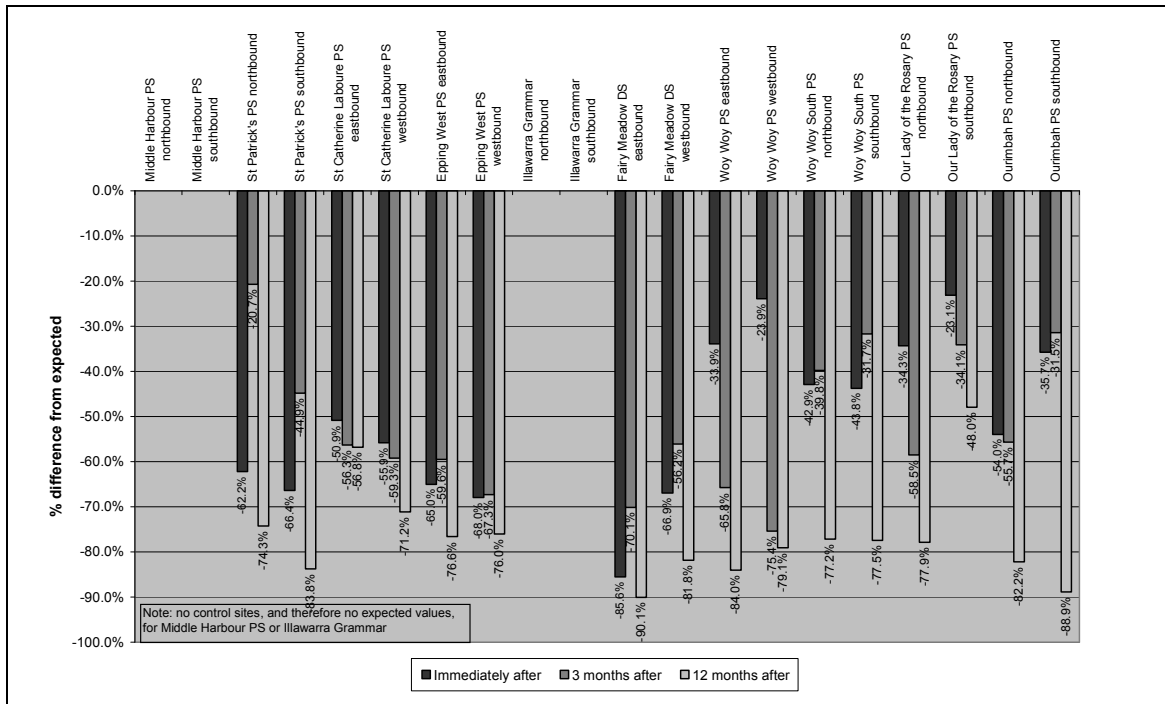


Figure 8: Difference between expected and actual percentages of vehicles exceeding the speed limit at treatment sites

2.2.4.4 Percentage of vehicles travelling more than 10 km/h above the speed limit

Only one of the speed camera sites showed an increase in the rate of vehicles exceeding the speed limit by more than 10 km/h. This was a marginal increase of 2.2 per cent (eastbound) for the immediate follow-up survey at Woy Woy Public School. Most sites exhibited large reductions (Figure 9). Half of the sites improved on these reductions for the three-month follow-up surveys. All sites other than St Catherine Laboure (eastbound) and Woy Woy (westbound) achieved their lowest results at the 12-month follow-up surveys.

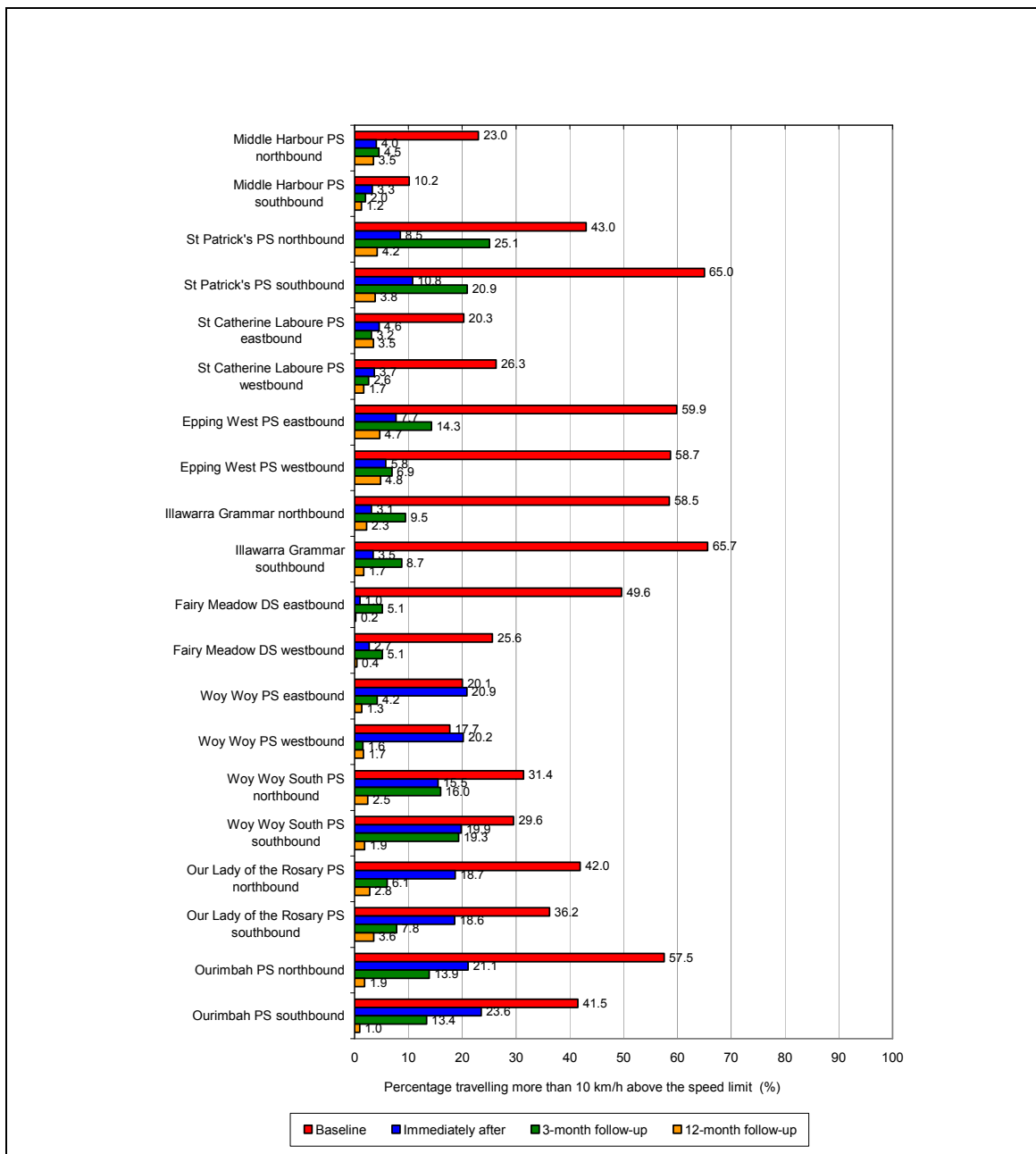


Figure 9: Percentage of vehicles travelling more than 10 km/h above the speed limit at camera sites

Comparison with control ratios (Figure 10) shows that seven of the eight controlled speed camera locations recorded large reductions attributable to the cameras at the immediate follow-up surveys while one site (Woy Woy Public School) exhibited a small increase. This increase was turned into a large decrease at the three-month follow-up survey. Most sites' reductions lessened at the three-month point and Ourimbah Public School showed an increase. After 12 months, all sites had shown large reductions.

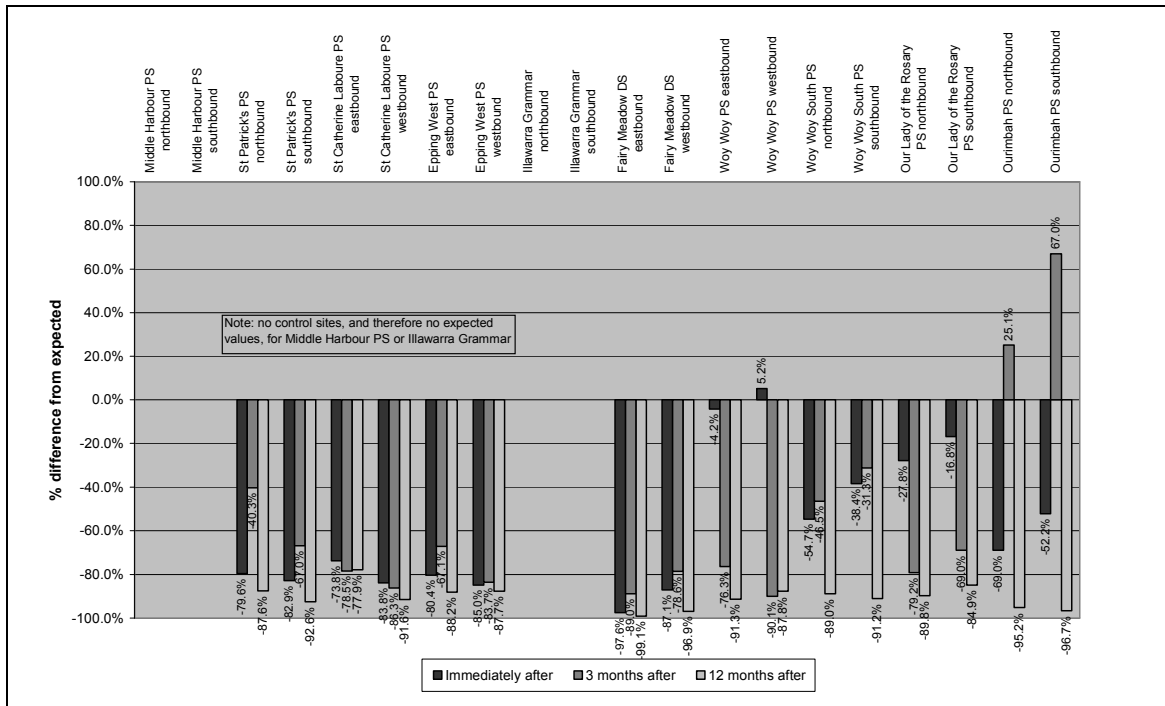


Figure 10: Difference between expected and actual percentages of vehicles exceeding the speed limit by more than 10 km/h at treatment sites

2.2.4.5 Percentage of vehicles travelling more than 20 km/h above the speed limit

Figure 11 shows that, with the exception of one site (Woy Woy), percentages of vehicles exceeding the speed limit by more than 20 km/h at speed camera sites were dramatically reduced at the immediate follow-up survey. The largest reduction was from 21.8 per cent to 0.8 per cent at the Epping West Public School site. The site at Woy Woy Public School experienced an increase in rate, though this was from a baseline that was quite low. Rates continued to decrease at six sites at the three-month follow-up surveys. At the 12-month surveys, all sites reached or equalled their lowest readings.

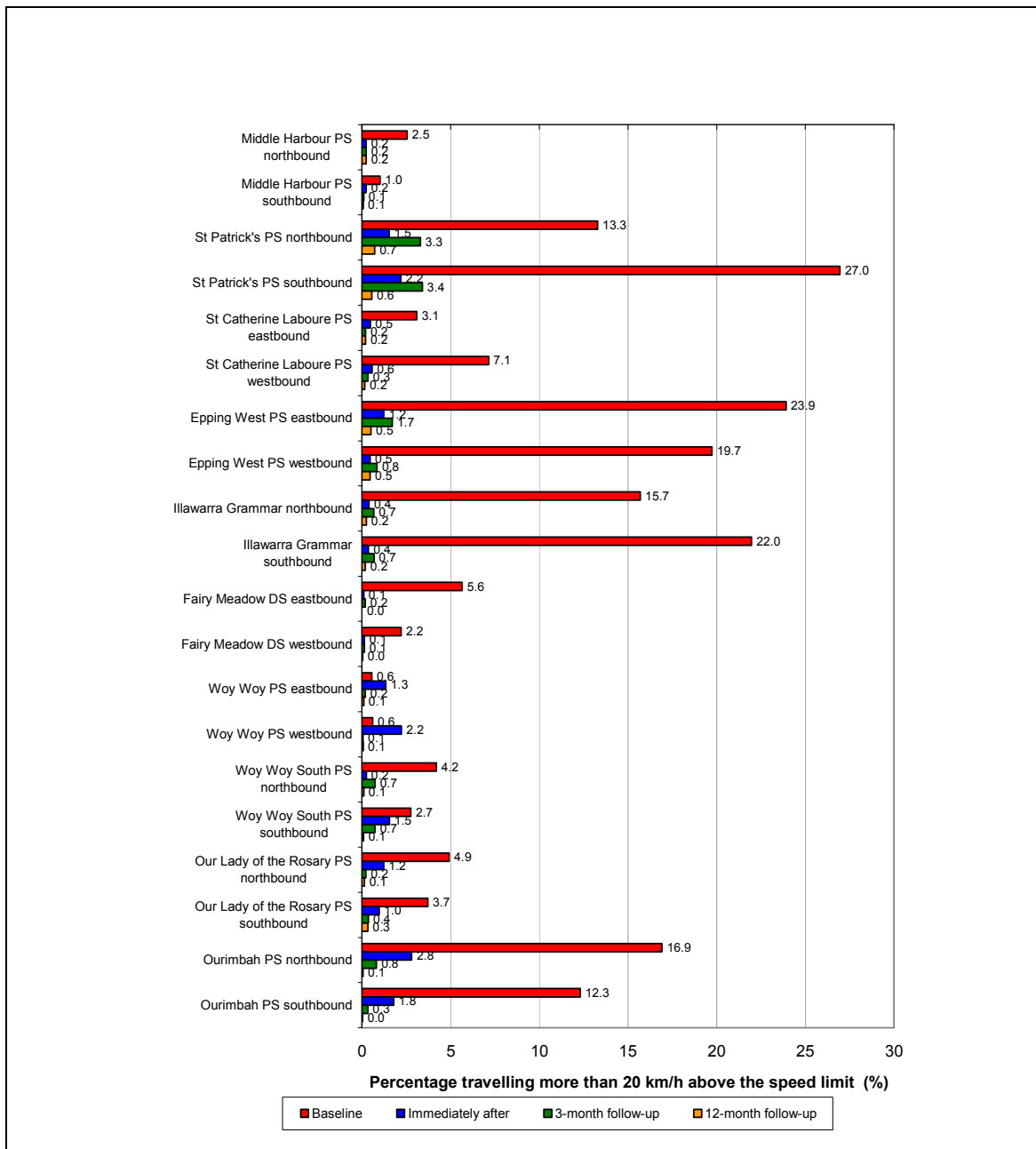


Figure 11: Percentage of vehicles travelling more than 20 km/h above the speed limit at camera sites

Figure 12 compares changes in proportions of vehicles exceeding the speed limit by more than 20 km/h with expected values. All of the speed camera sites showed large reductions in the rate of speeding at this level, with the exception of one (Woy Woy Public School) that experienced an initial increase in the immediate follow-up survey before reducing at the three-month follow-up survey. After the 12-month follow-up survey, all sites had achieved at least 77 per cent reductions from expected values.

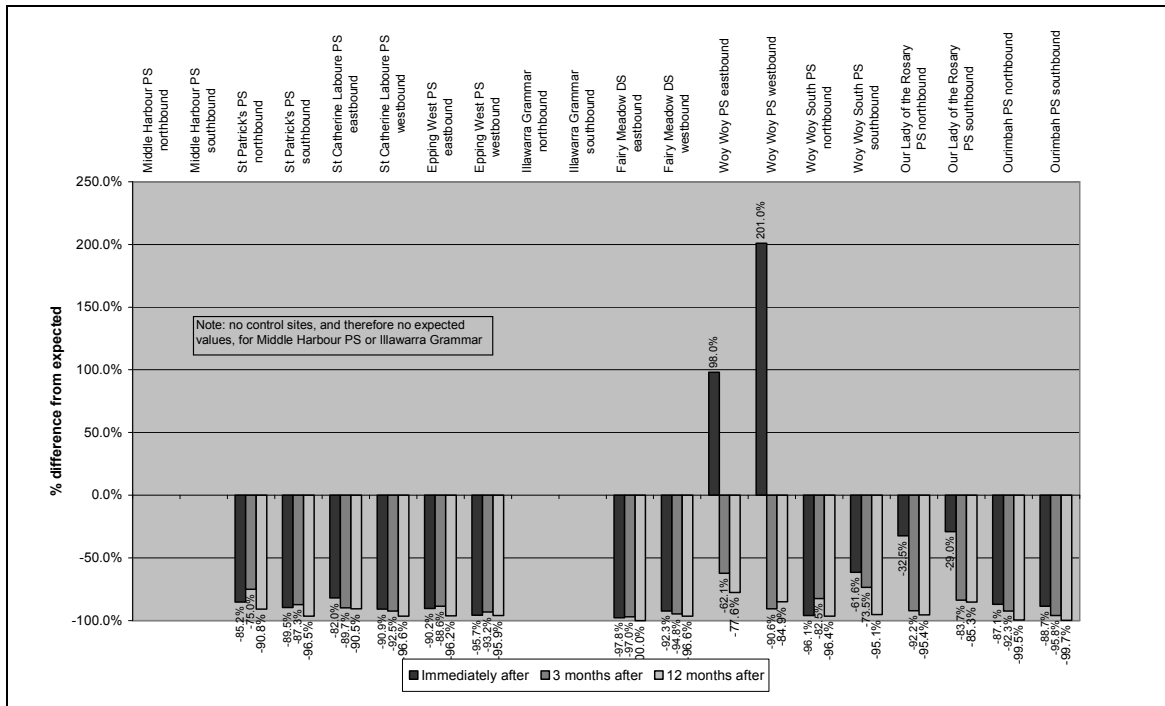


Figure 12: Difference between expected and actual percentages of vehicles exceeding the speed limit by more than 20 km/h at treatment sites

2.2.4.6 Percentage of vehicles travelling more than 30 km/h above the speed limit

Figure 13 below shows that the proportion of vehicles exceeding the limit by more than 30 km/h at the speed camera sites was reduced to nearly zero in most cases at the immediate follow-up point. Figures at the three-month follow-up surveys remained extremely low and even at sites where initial rates were highest, by the 12-month follow-up survey the rates were down to zero.

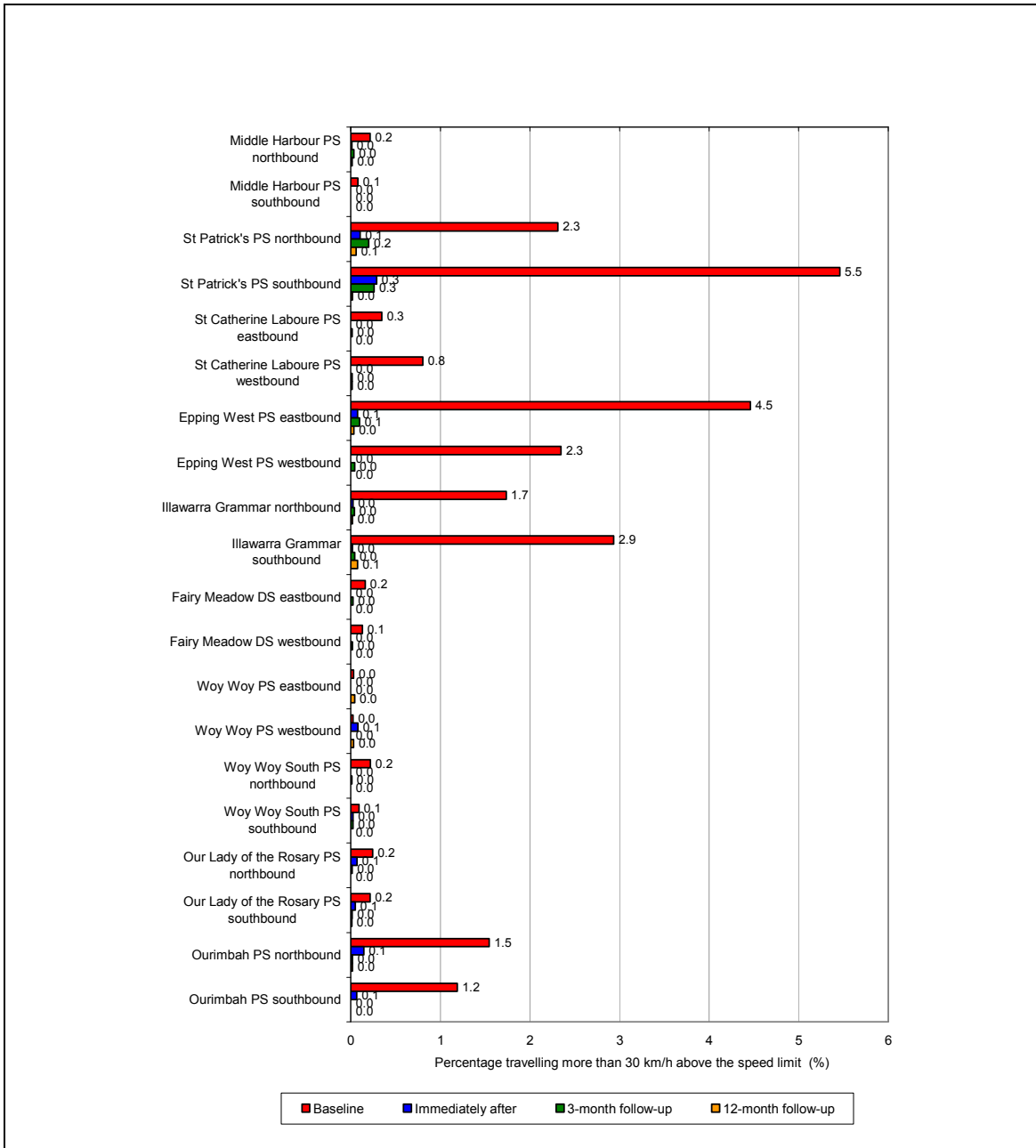


Figure 13: Percentage of vehicles travelling more than 30 km/h above the speed limit at camera sites

As can be seen in Figure 14 below, the proportion of vehicles exceeding the limit by more than 30 km/h at most of the controlled camera sites was reduced to almost zero at the immediate follow-up surveys after allowance was made for control ratios. At the three-month follow-up surveys, some sites' reductions were slightly eroded but most sites returned to zero by the 12-month follow-up surveys. It should be noted that very small numerical differences between treatment and control sites can appear as very large percentages, due to the very small proportions of vehicles exceeding the speed limit by this margin (typically less than 0.5%). For example, the 200 per cent difference between the actual and expected value at Woy Woy PS (westbound) was caused by the speeding rate at the site increasing from 0.0 to 0.1 per cent while the control site remained at 0.4 per cent.

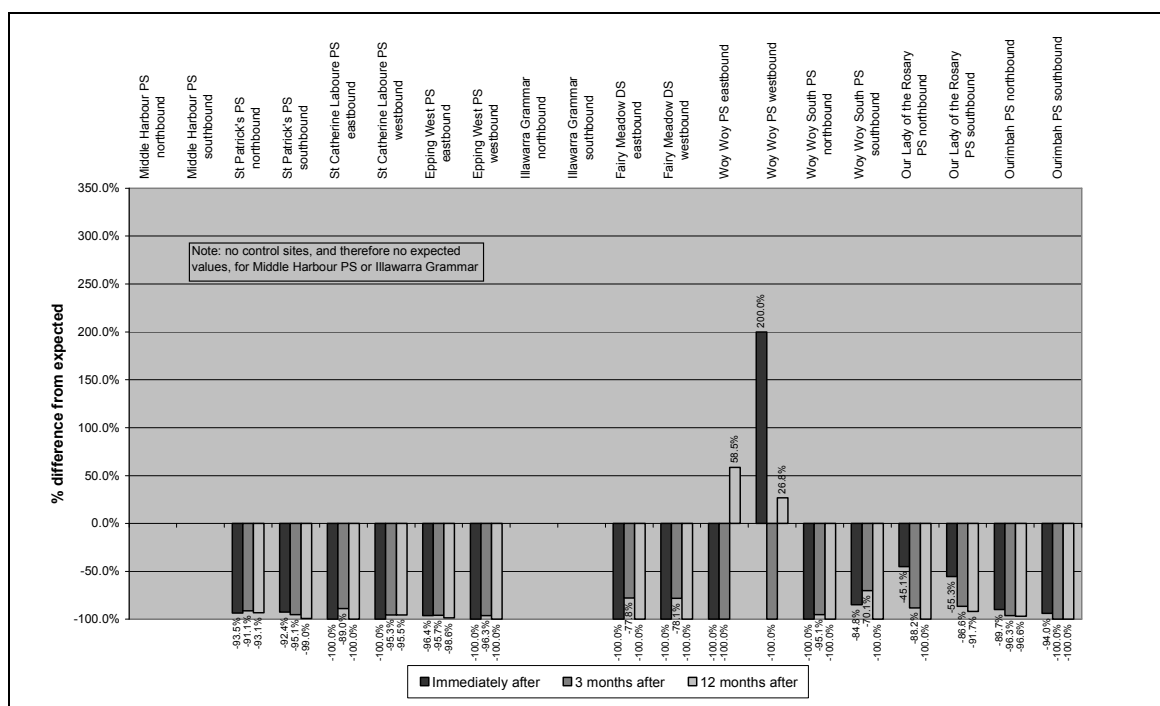


Figure 14: Difference between expected and actual percentages of vehicles exceeding the speed limit by more than 30 km/h at treatment sites

2.3 Heavy vehicle speed characteristics at the school zone

2.3.1 Recorded data by site

Tables 8 to 11 show the recorded speed results for heavy vehicles across all fixed digital speed camera sites. These tables show that heavy vehicle speeds and speeding rates decreased across all treatment sites by the end of the 12 month evaluation period. This is consistent with the trends noted across all vehicles, although the speeds and speeding rates among heavy vehicles were lower than those for all vehicles. At nearly all sites, the 85th percentile speeds of heavy vehicles were below the 40 km/h speed limit at the 12-month follow-up surveys. Speeds and speeding rates at control sites were substantially higher. A control ratio analysis has not been performed for the heavy vehicle figures and accordingly the level of influence of the speed cameras on heavy vehicle speeds is not stated.

Table 8: Recorded percentages of heavy vehicles in the survey for all speed camera sites

School	Direction	Heavy vehicle proportions (%)			
		Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'
Treatment sites					
Middle Harbour PS**	N	2.6	3.6	3.3	3.5
	S	2.9	2.8	3.1	3.0
St Patrick's PS	N	6.5	6.4	6.0	6.6
	S	8.9	8.2	7.7	7.4
St Catherine Laboure PS	E	4.3	4.6	3.2	2.9
	W	8.7	5.3	5.9	4.4
Epping West PS	E	3.2	3.4	3.0	3.4
	W	6.0	5.6	5.3	5.6
Illawarra Grammar	N	4.6	8.1	4.8	4.4
	S	4.6	5.9	5.0	5.4
Fairy Meadow PS	E	4.7	5.1	3.6	3.8
	W	4.7	5.8	4.0	4.4
Woy Woy PS	E	4.3	4.0	4.8	4.9
	W	3.6	5.5	3.7	5.7
Woy Woy South PS	N	4.4	3.6	4.9	4.7
	S	6.9	6.4	6.0	6.7
Our Lady of the Rosary PS	N	4.4	2.9	3.1	3.5
	S	3.0	3.3	2.7	3.5
Ourimbah PS	N	13.7	14.3	13.1	13.1
	S	14.3	9.6	13.8	11.1
Control sites					
Lindfield PS (control for St Patrick's PS)		6.7	6.5	6.8	7.4
Croydon Park PS (control for St Catherine Laboure)		10.3	8.2	6.1	6.7
Kellyville PS (control for Epping West PS)		9.9	8.1	9.2	8.7
St John Vianney's (control for Fairy Meadow DS)		2.4	2.8	2.6	2.8
Adamstown PS (control for Woy Woy PS)		4.5	4.5	5.2	5.1
Charlestown East PS (control for Woy Woy South PS)		5.4	4.4	4.7	5.2
Niagara Park PS (control for Our Lady of the Rosary PS)		4.3	4.1	5.5	5.2
Cardiff PS (control for Ourimbah PS)		8.0	6.2	6.2	7.0

* No control schools were available for Middle Harbour Public School and Illawarra Grammar School

+ Middle Harbour PS was the only site with a 50 km/h non-school hours limit. All other sites had a 60 km/h limit.

Table 9: Recorded mean and 85th percentile speed results for all speed camera sites, heavy vehicles only

School	Direction	Mean speed (km/h)				85 th percentile speed (km/h)			
		Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'	Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'
Treatment sites									
Middle Harbour PS	N	41.7	37.0	37.4	36.3	48.0	43.0	45.0	40.0
	S	34.7	32.6	32.1	31.6	40.0	37.0	37.0	38.0
St Patrick's PS	N	39.4	32.5	37.8	32.5	44.0	35.0	46.0	33.0
	S	48.5	35.2	39.3	33.3	59.0	45.0	50.0	39.0
St Catherine Laboure PS	E	37.5	31.1	30.7	32.0	38.7	36.0	36.0	37.0
	W	39.9	33.9	33.3	32.8	53.0	39.0	38.0	37.0
Epping West PS	E	45.9	35.5	35.8	34.9	56.0	40.8	44.0	40.0
	W	45.7	34.6	36.7	35.5	53.0	39.0	40.0	39.0
Illawarra Grammar	N	45.4	30.9	34.6	33.8	53.0	37.0	41.0	38.0
	S	48.3	31.5	36.5	34.1	55.0	35.0	45.0	38.0
Fairy Meadow DS	E	44.1	33.1	34.7	33.5	53.7	37.0	42.0	37.0
	W	45.3	34.4	35.8	33.8	50.9	40.0	41.0	39.8
Woy Woy PS	E	36.6	37.5	33.9	33.8	47.0	48.2	39.0	37.0
	W	39.1	38.2	34.9	33.4	47.9	48.0	41.8	39.0
Woy Woy South PS	N	42.0	37.7	39.4	35.0	50.0	48.0	49.4	41.0
	S	43.1	37.7	40.4	35.2	52.5	43.0	50.0	39.0
Our Lady of the Rosary PS	N	44.0	38.6	37.1	35.7	51.3	47.9	44.0	39.0
	S	44.7	39.2	38.7	38.2	50.0	46.0	43.0	42.0
Ourimbah PS	N	49.5	37.2	38.5	34.9	57.5	48.0	50.0	40.0
	S	44.8	35.8	37.1	29.6	57.0	50.3	49.5	32.0
Control sites									
Lindfield PS (control for St Patrick's PS)		49.4	50.0	49.1	44.1	57.7	55.0	54.7	53.7
Croydon Park PS (control for St Catherine Laboure PS)		36.8	37.2	36.2	36.6	49.0	52.0	46.0	47.0
Kellyville PS (control for Epping West PS)		50.5	46.3	47.7	42.0	62.0	55.0	58.0	50.0
St John Vianney's (control for Fairy Meadow PS)		42.0	39.0	42.6	44.0	51.0	47.0	51.7	51.3
Adamstown PS (control for Woy Woy PS)		42.9	44.7	44.0	49.5	50.3	55.1	54.0	57.5
Charlestown East PS (control for Woy Woy South PS)		49.3	49.7	47.3	49.4	58.0	63.0	58.0	57.7
Niagara Park PS (control for Our Lady of the Rosary PS)		42.0	39.5	39.1	36.8	47.9	46.6	47.4	49.0
Cardiff PS (control for Ourimbah PS)		47.3	48.5	44.4	50.5	55.0	56.0	51.0	62.0

* No control schools were available for Middle Harbour Public School and Illawarra Grammar School

+ Middle Harbour PS was the only site with a 50 km/h non-school hours limit. All other sites had a 60 km/h limit.

Table 10: Recorded percentages of vehicles travelling over the speed limit and more than 10 km/h over the limit for all speed camera sites, heavy vehicles only

School	Direction	% travelling above speed limit				% more than 10 km/h over limit			
		Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'	Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'
Treatment sites									
Middle Harbour PS**	N	56.2	19.6	25.9	18.2	10.4	1.7	2.5	3.0
	S	11.6	6.0	5.7	7.2	2.9	0.0	1.1	0.9
St Patrick's PS	N	48.8	14.7	37.0	12.4	18.3	3.3	9.8	2.6
	S	81.0	19.2	41.8	7.2	42.5	5.2	10.8	1.4
St Catherine Laboure PS	E	33.5	8.2	6.8	10.8	9.6	1.4	0.5	0.9
	W	39.1	8.4	7.0	6.1	11.0	0.8	0.7	0.6
Epping West PS	E	69.9	16.3	18.4	12.5	38.0	2.9	6.7	3.5
	W	73.5	14.0	18.4	13.8	32.2	0.3	2.3	2.2
Illawarra Grammar	N	69.3	4.5	14.9	8.2	29.3	0.7	3.6	1.8
	S	81.0	3.8	19.1	5.7	41.4	0.5	5.5	2.9
Fairy Meadow DS	E	67.8	5.9	15.8	7.2	26.7	0.5	1.3	0.0
	W	77.8	11.3	14.5	10.1	22.2	0.0	0.6	0.0
Woy Woy PS	E	40.3	30.3	8.7	7.8	10.8	9.4	0.8	1.6
	W	48.8	34.9	16.4	9.4	14.9	10.1	0.9	1.3
Woy Woy South PS	N	52.5	30.5	37.7	16.8	21.8	8.4	12.1	3.2
	S	62.3	24.1	41.7	7.0	21.8	7.9	12.1	2.6
Our Lady of the Rosary PS	N	67.5	35.5	22.9	13.7	23.7	7.6	4.0	1.1
	S	70.3	33.0	27.8	30.7	22.2	9.1	1.5	3.5
Ourimbah PS	N	87.0	28.5	31.9	11.3	43.9	9.6	10.2	0.9
	S	64.6	25.8	35.2	4.3	36.8	10.9	9.3	0.6
Control sites									
Lindfield PS (control for St Patrick's PS)		85.2	90.3	87.7	67.8	48.3	43.6	42.6	26.7
Croydon Park PS (control for St Catherine Laboure)		37.1	36.6	34.8	40.3	10.6	12.3	8.8	10.8
Kellyville PS (control for Epping West PS)		82.5	70.1	77.6	52.5	53.7	34.7	37.5	21.8
St John Vianney's (control for Fairy Meadow PS)		57.3	43.5	54.6	67.5	23.0	10.4	22.6	23.7
Adamstown PS (control for Woy Woy PS)		57.8	66.2	64.2	87.0	20.1	27.3	25.4	43.9
Charlestown East PS (control for Woy Woy South PS)		85.1	82.9	80.1	85.2	44.2	47.3	34.1	48.3
Niagara Park PS (control for Our Lady of the Rosary)		54.6	43.9	41.4	37.1	18.0	11.0	9.7	10.6
Cardiff PS (control for Ourimbah PS)		75.9	76.8	64.3	82.5	40.4	47.0	25.5	53.7

* No control schools were available for Middle Harbour Public School and Illawarra Grammar School

+ Middle Harbour PS was the only site with a 50 km/h non-school hours limit. All other sites had a 60 km/h limit.

Table 11: Recorded percentages of vehicles more than 20 and 30 km/h over the limit for all speed camera sites, heavy vehicles only

School	Direction	% more than 20 km/h over limit				% more than 30 km/h over limit			
		Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'	Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'
Treatment sites									
Middle Harbour PS**	N	0.0	0.9	1.5	1.1	0.0	0.4	0.5	0.4
	S	0.6	0.0	0.0	0.0	0.6	0.0	0.0	0.0
St Patrick's PS	N	3.4	0.7	0.7	0.7	0.6	0.0	0.0	0.4
	S	10.4	1.5	0.9	0.1	1.1	0.5	0.0	0.1
St Catherine Laboure PS	E	0.9	0.0	0.0	0.5	0.0	0.0	0.0	0.0
	W	2.3	0.5	0.0	0.0	0.5	0.0	0.0	0.0
Epping West PS	E	9.0	0.8	0.7	0.0	1.1	0.0	0.0	0.0
	W	4.0	0.3	0.0	0.3	0.3	0.0	0.0	0.0
Illawarra Grammar	N	5.2	0.3	0.0	0.5	0.0	0.1	0.0	0.2
	S	6.7	0.0	0.8	2.0	0.5	0.0	0.4	1.4
Fairy Meadow DS	E	1.0	0.0	0.6	0.0	0.0	0.0	0.6	0.0
	W	1.6	0.0	0.6	0.0	0.0	0.0	0.0	0.0
Woy Woy PS	E	0.5	0.3	0.4	0.7	0.5	0.0	0.0	0.7
	W	0.6	1.0	0.0	0.5	0.0	0.0	0.0	0.3
Woy Woy South PS	N	3.4	0.0	0.5	0.6	0.6	0.0	0.0	0.0
	S	2.8	0.4	0.6	0.6	0.0	0.4	0.2	0.0
Our Lady of the Rosary PS	N	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	S	1.3	0.8	0.0	0.4	0.0	0.4	0.0	0.0
Ourimbah PS	N	7.3	0.9	0.3	0.1	0.2	0.0	0.0	0.1
	S	9.3	0.4	0.2	0.0	0.6	0.0	0.0	0.0
Control sites									
Lindfield PS (control for St Patrick's PS)		8.3	8.9	6.9	1.0	0.8	2.2	0.8	0.0
Croydon Park PS (control for St Catherine Laboure)		0.6	4.2	1.0	0.5	0.1	1.6	0.1	0.5
Kellyville PS (control for Epping West PS)		16.5	7.6	11.2	3.4	2.0	1.0	1.4	0.6
St John Vianney's (control for Fairy Meadow PS)		2.8	1.0	3.7	3.2	0.6	0.0	1.1	0.0
Adamstown PS (control for Woy Woy PS)		3.2	4.7	2.6	7.3	0.6	1.1	0.3	0.2
Charlestown East PS (control for Woy Woy South PS)		9.6	12.7	5.2	8.3	1.1	1.5	0.5	0.8
Niagara Park PS (control for Our Lady of the Rosary PS)		2.1	0.2	1.2	0.6	0.2	0.0	0.0	0.1
Cardiff PS (control for Ourimbah PS)		8.8	10.1	4.4	16.5	3.4	1.6	0.7	2.0

* No control schools were available for Middle Harbour Public School and Illawarra Grammar School

+ Middle Harbour PS was the only site with a 50 km/h non-school hours limit. All other sites had a 60 km/h limit.

2.4 Individual site comparisons of 85th percentile speeds – school speed zones and approaches

This section describes the 85th percentile speeds at the school zone sites and in the approach lengths for each direction.

In this section there are two graphs for each site. Both graphs describe the speed recorded at the following sites:

- On the approach to the school zone.
- In the school zone.

No data were available for the Middle Harbour Public School southbound approach length, therefore its southbound graph only shows figures for the school zone length.

The two graphs each describe a single direction of travel. Figure 1 describes the speed survey locations and directions. Note that at Fairy Meadow, Woy Woy, Woy Woy South, Our Lady of the Rosary and Ourimbah, the school zone lengths' survey directions were combined. This has resulted in identical pairs of bars being displayed in each of the two school zone charts for each site.

2.4.1 Middle Harbour Public School

Northbound 85th percentile speeds in the school zone were consistently lower than speeds in the approach. There were no data for the southbound approach. Immediately after commencement of operation of the cameras, speeds in the school zone (both directions) and the northbound approach had reduced. After three months of camera operation, speeds in the northbound approach had remained steady, and continued to reduce in the school zone for the northbound direction. A slight increase was observed for the southbound direction in the school zone after three months. At the 12-month point, all survey locations had reached their lowest speeds, well below baseline level.

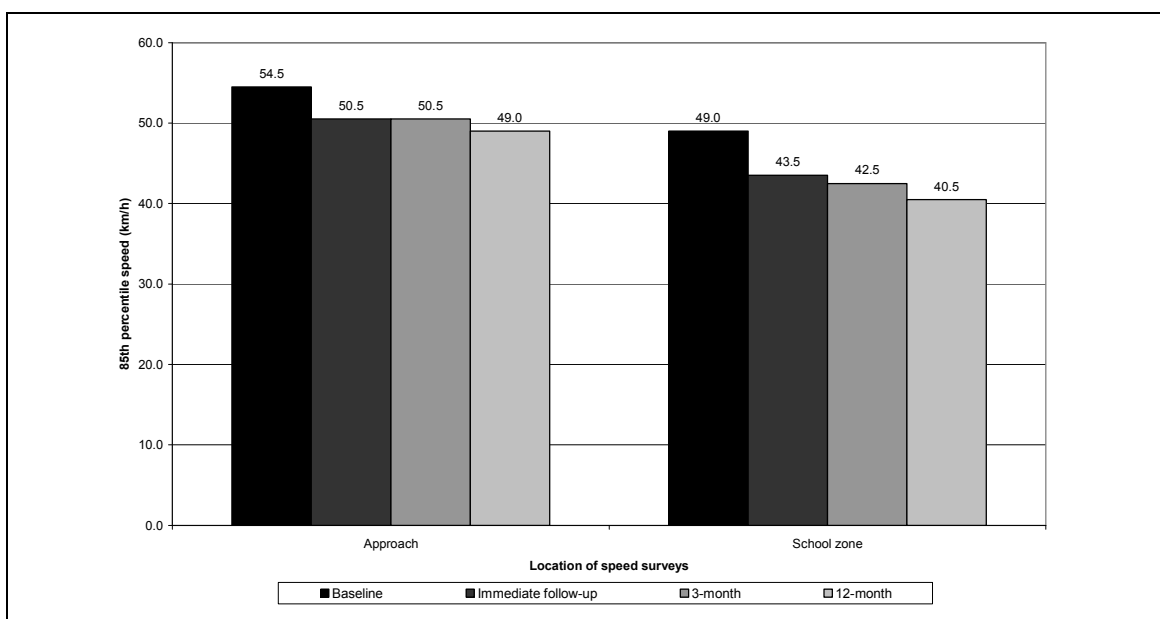


Figure 15: 85th percentile speed on the approach to the school zone and at the school zone, Middle Harbour Public School, northbound

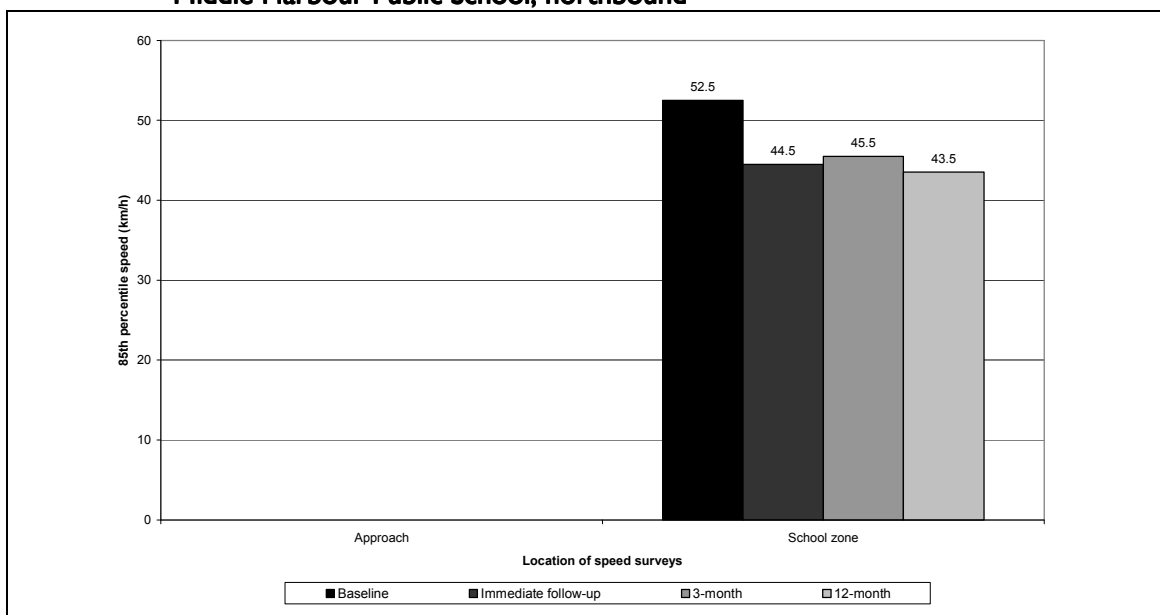


Figure 16: 85th percentile speed at the school zone, Middle Harbour Public School, southbound

2.4.2 St Patrick's Primary School

The 85th percentile speeds for this site reduced at all locations for the immediate follow-up surveys. Dramatic reductions were experienced at the school zone for both directions (14–17.5 km/h). Speeds then increased at all sites after the three-month follow-up surveys. Within the school zone, these speeds were still lower than speeds observed during the baseline survey. However the 85th percentile speeds were higher in the approaches after three months than during the baseline survey. At the 12-month surveys the speeds reduced again and, at all survey locations, reached their lowest levels for the evaluation. The school zone values were well below baseline levels.

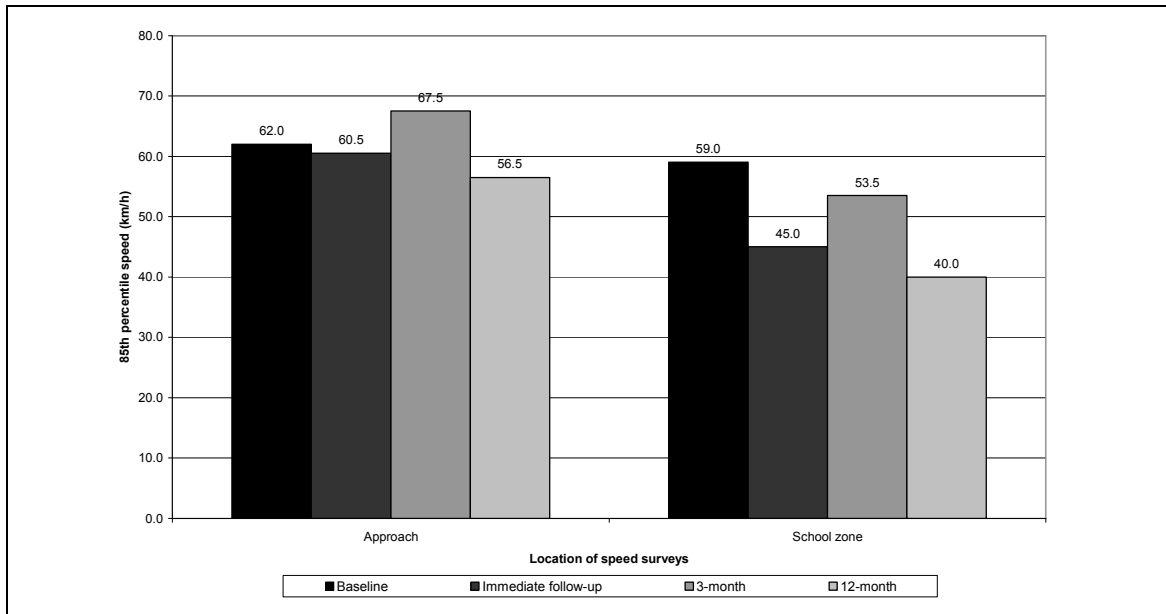


Figure 17: 85th percentile speed on the approach to the school zone and at the school zone, St Patrick's Primary School, northbound

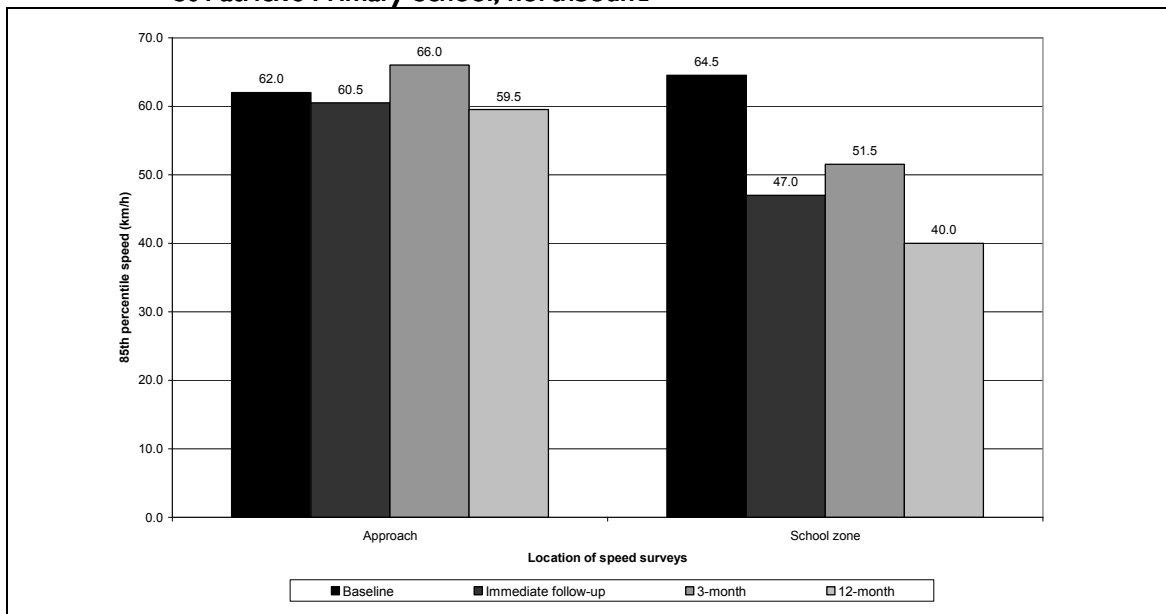


Figure 18: 85th percentile speed on the approach to the school zone and at the school zone, St Patrick's Primary School, southbound

2.4.3 St Catherine Laboure Primary School

Speeds in the school zone were consistently lower than speeds in the approaches. Immediately after commencement of operation of the cameras, large reductions were experienced at the school zones (8 –11 km/h), with smaller reductions on the approaches. The three-month follow-up surveys showed speeds in most locations continued to reduce, except for the eastbound approach which showed a slight increase. At 12 months, the eastbound approach continued to increase and there was a very small increase in the eastbound school zone and the westbound approach too, but all locations remained below baseline, especially in the school zone.

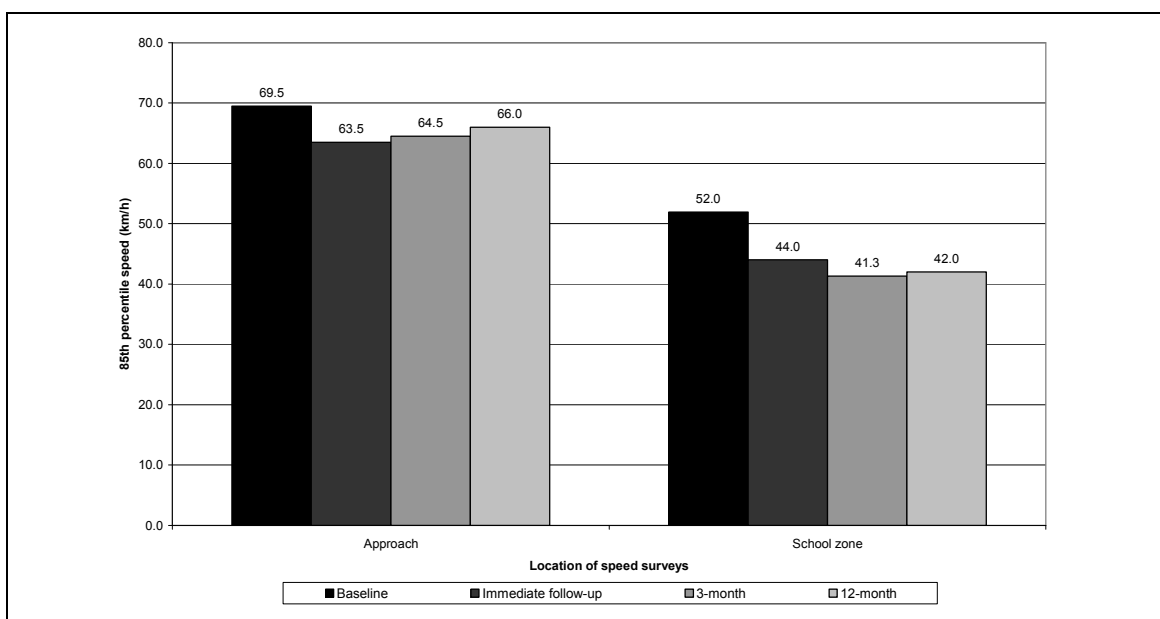


Figure 19: 85th percentile speed on the approach to the school zone and at the school zone, St Catherine Laboure Primary School, eastbound

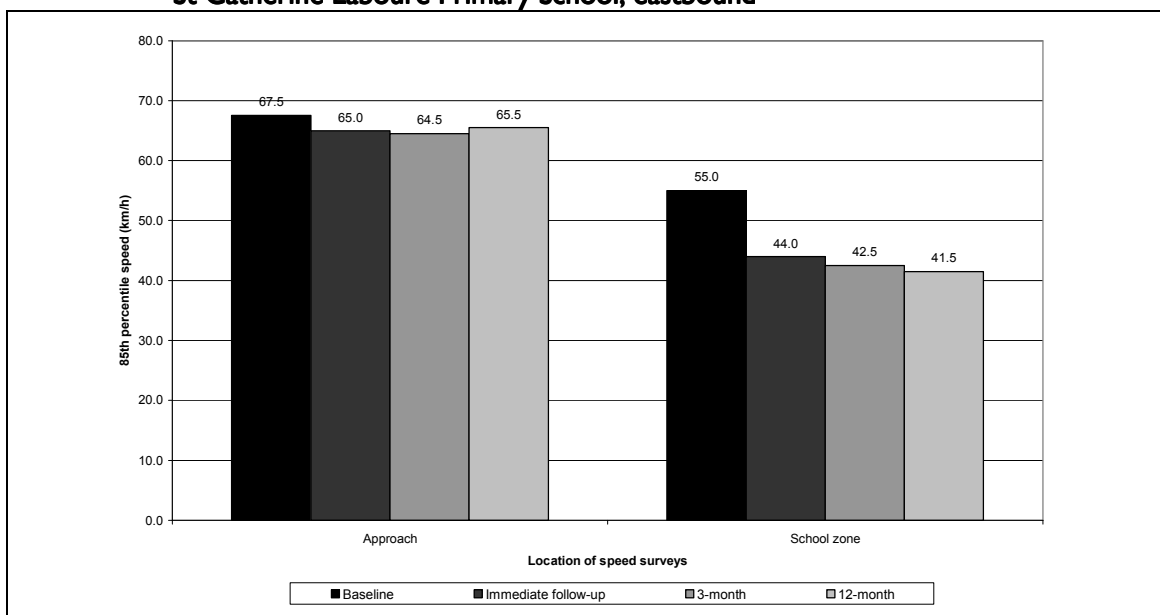


Figure 20: 85th percentile speed on the approach to the school zone and at the school zone, St Catherine Laboure Primary School, westbound

2.4.4 Epping West Public School

Speeds in the school zone were consistently lower than speeds on the approaches. Reductions were experienced at the school zones and the approaches for the immediate follow-up survey. At this time, dramatic reductions were experienced at the school zone for both directions (17.7-18.5 km/h). Reductions continued for the three-month surveys for the westbound approaches and school zones, however increases were observed for the eastbound approach and school zone. At the 12-month point there were further reductions to well below baseline level in the school zone, with the eastbound reduction being larger than the westbound. Speeds increased slightly at this survey point in the approaches.

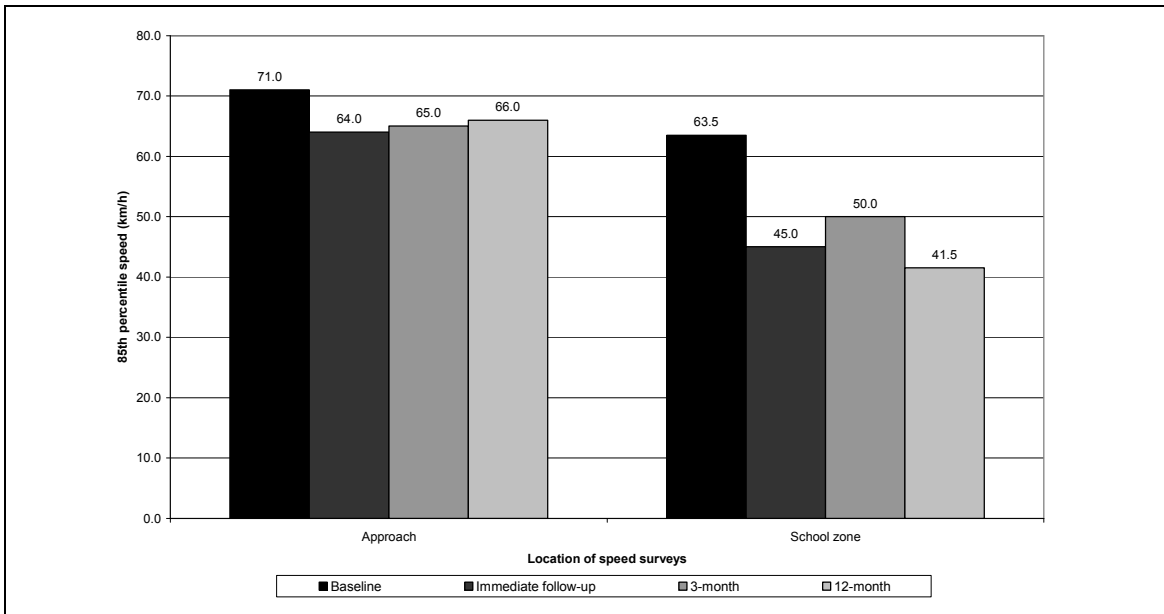


Figure 21: 85th percentile speed on the approach to the school zone and at the school zone, Epping West Public School, eastbound

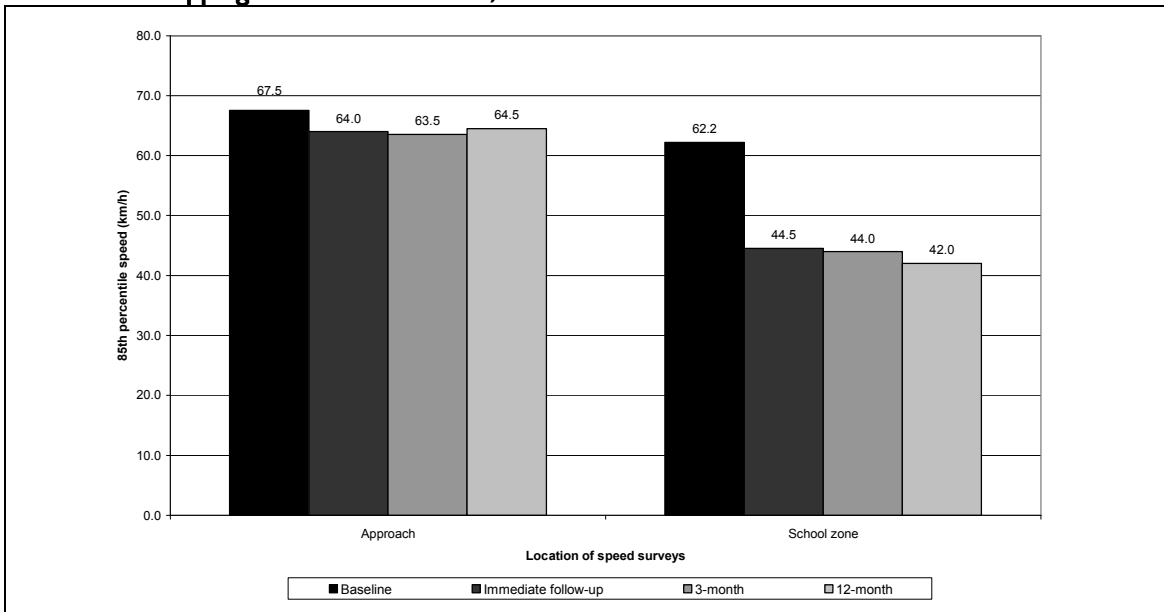


Figure 22: 85th percentile speed on the approach to the school zone and at the school zone, Epping West Public School, westbound

2.4.5 Illawarra Grammar School

Reductions were experienced at all locations at the immediate follow-up survey. The 85th percentile speeds at the school zones decreased by 20 – 21.5 km/h. The three-month follow-up surveys showed increases within the school zone (both directions) and the northbound approach, however speeds remained lower than observed during the baseline survey. At the 12-month point there were further reductions to well below baseline level in the school zone but the reduction in the northbound approach was very small and the westbound approach showed an increase.

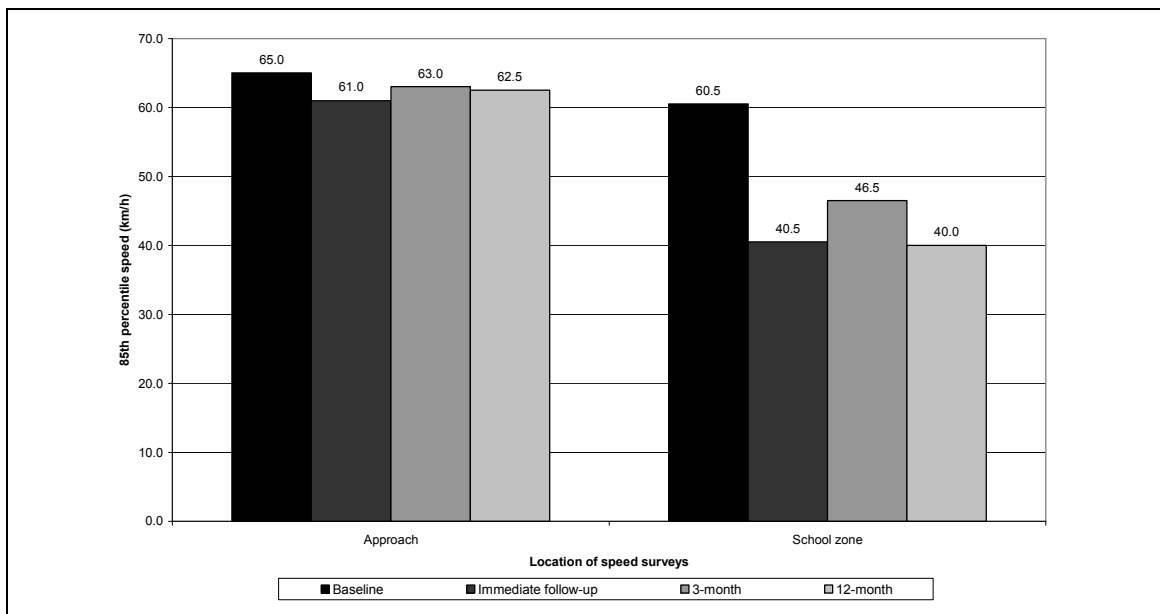


Figure 23: 85th percentile speed on the approach to the school zone and at the school zone, Illawarra Grammar School, northbound

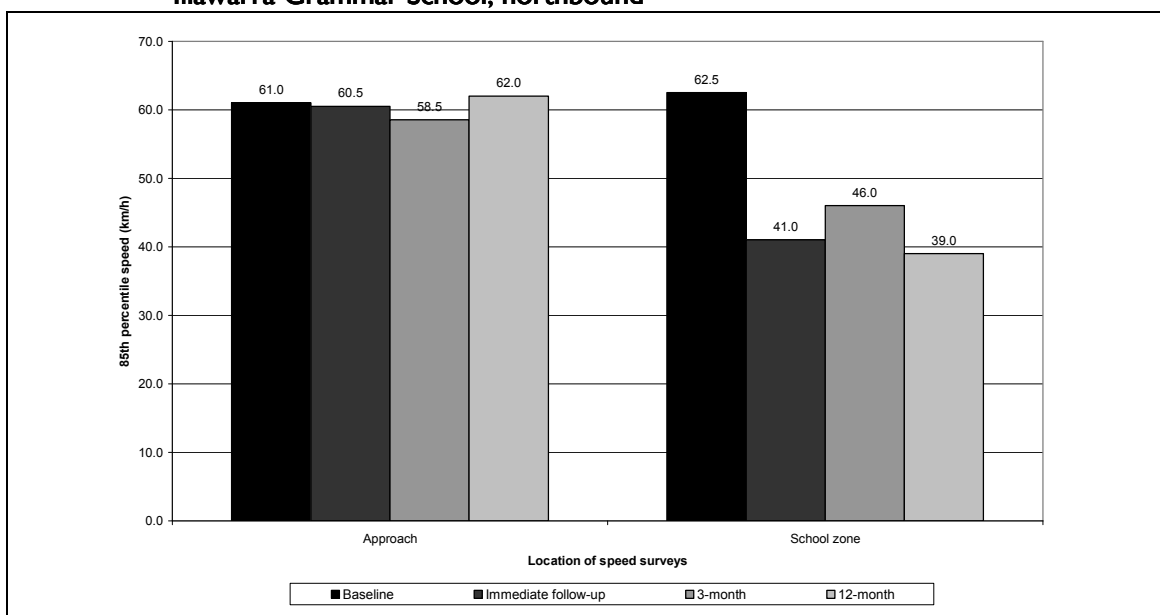


Figure 24: 85th percentile speed on the approach to the school zone and at the school zone, Illawarra Grammar School, southbound

2.4.6 Fairy Meadow Demonstration School

There were no data for the westbound approach. Immediately after commencement of operation of the cameras, reductions in the 85th percentile speeds were experienced in the school zone (both directions) and the eastbound approach. Increases were observed at these three locations at the three-month follow-up survey, however, speeds were still lower than observed during the baseline survey by between 3.5 and 15 km/h. At 12 months, speeds reduced to well below baseline levels at all survey locations but the speed recorded on the eastbound approach was still higher (at 58.5 km/h) than the lowest achieved at that location (55 km/h at the immediate follow-up).

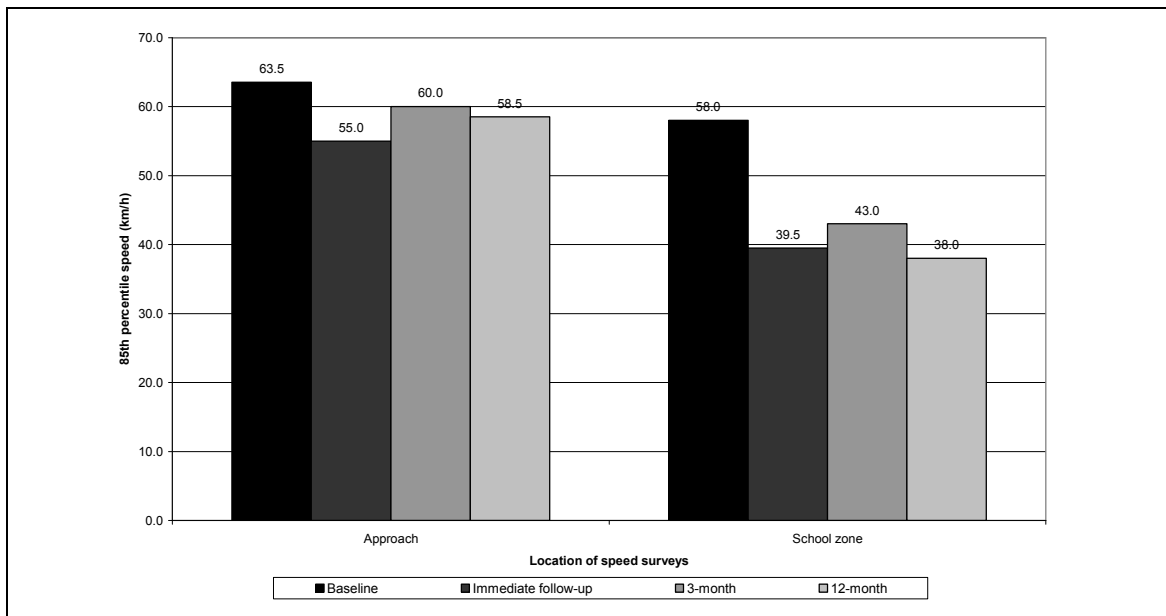


Figure 25: 85th percentile speed on the approach to the school zone and at the school zone, Fairy Meadow Demonstration School, eastbound

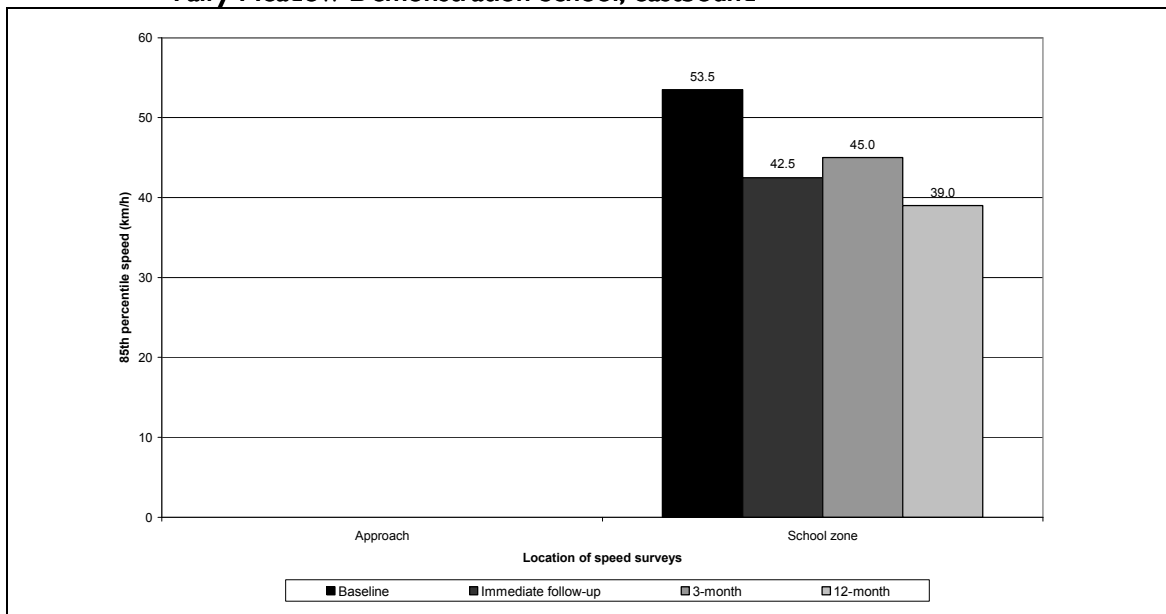


Figure 26: 85th percentile speed on the approach to the school zone and at the school zone, Fairy Meadow Demonstration School, westbound

2.4.7 Woy Woy Public School

Immediately after commencement of operation of the cameras, small increases were experienced at three of the four locations (only the westbound approach exhibited a small reduction). However, the three-month follow-up surveys showed reductions at the school zone (both directions) and the eastbound approach of 9.5-11.5 km/h, while there was a slight increase for the westbound approach. The 12-month survey showed further reductions to well below baseline levels at all locations other than the eastbound approach, where the speed increased nearly to its baseline level.

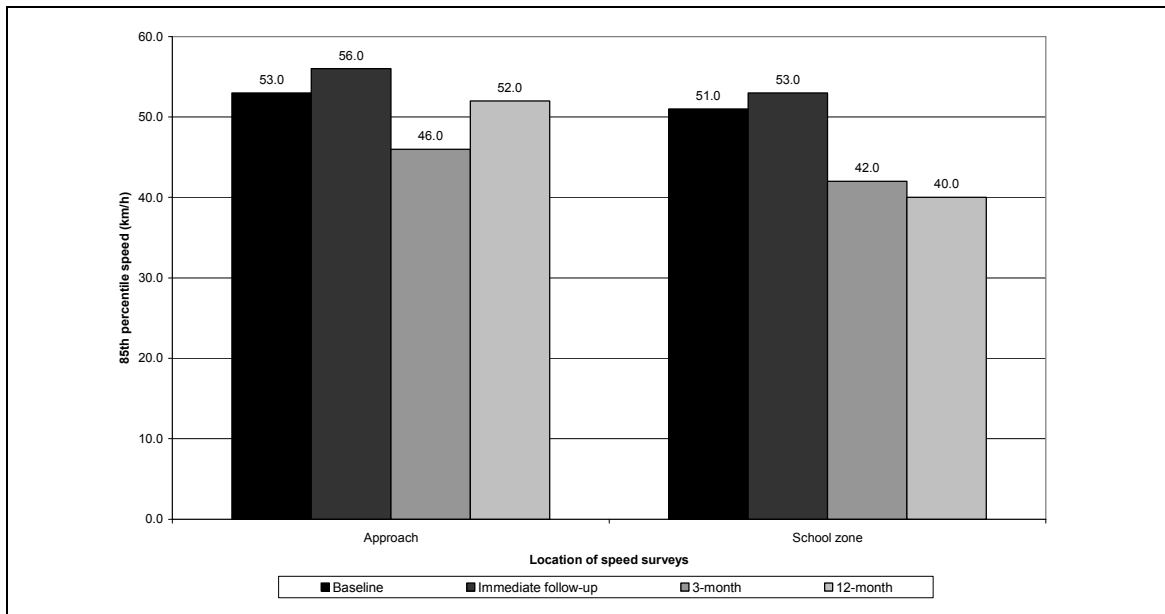


Figure 27: 85th percentile speed on the approach to the school zone and at the school zone, Woy Woy Public School, eastbound (combined directions in school zone)

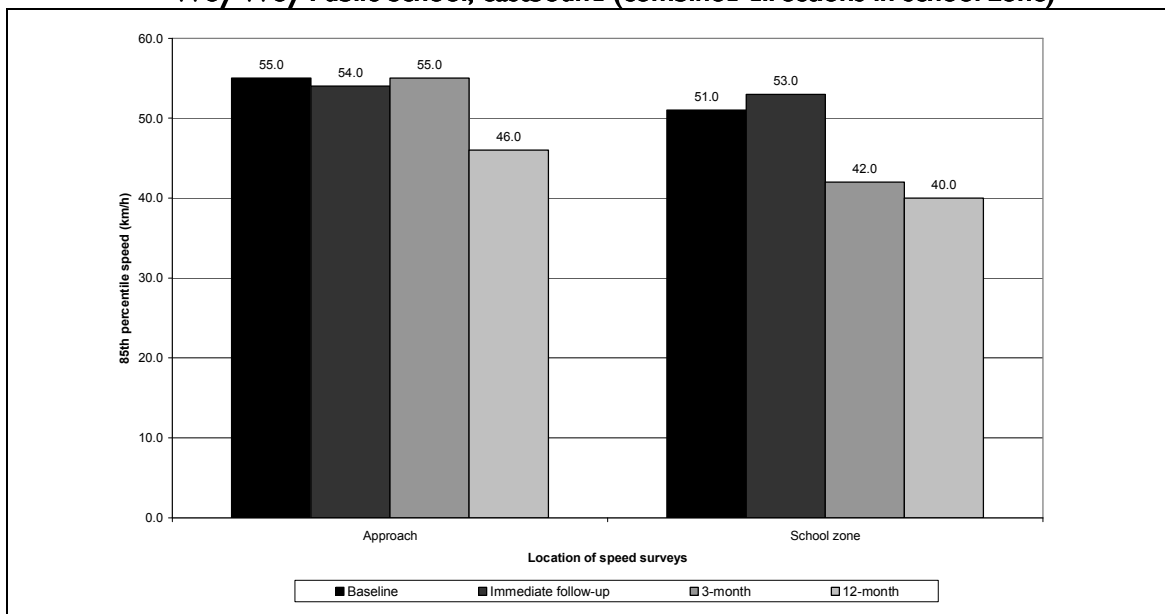


Figure 28: 85th percentile speed on the approach to the school zone and at the school zone, Woy Woy Public School, westbound (combined directions in school zone)

2.4.8 Woy Woy South Public School

Reductions of around 3 km/h in 85th percentile speeds were experienced in the school zones in the immediate follow-up surveys. A smaller reduction was seen at the southbound approach (there were no baseline survey data available for the northbound approach). The speeds continued to decrease or remained stable for all locations for the three-month surveys. The school zone locations reduced speed substantially between the 3-month and 12-month surveys, finishing well below the baseline levels, but speeds remained level during this period for the approaches.

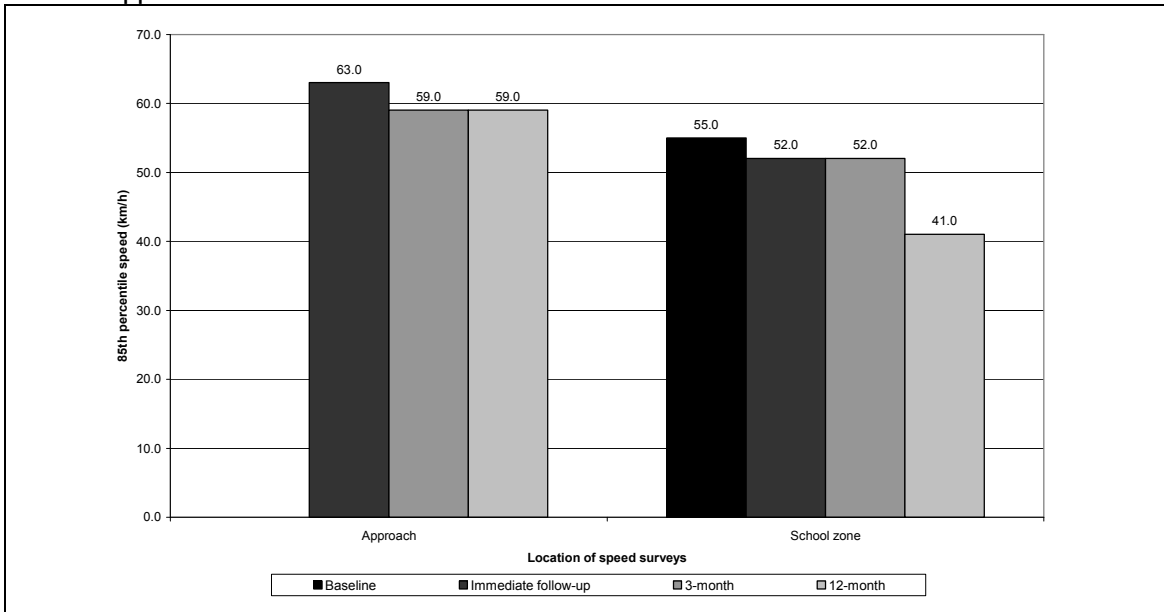


Figure 29: 85th percentile speed on the approach to the school zone and at the school zone, Woy Woy South Public School, northbound (combined directions in school zone)

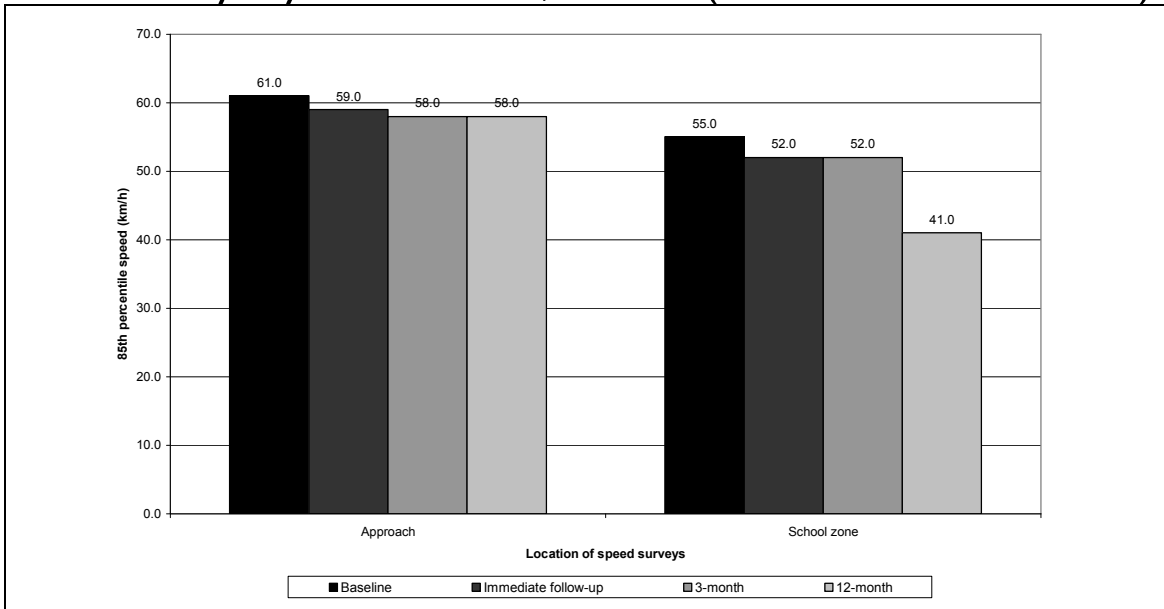


Figure 30: 85th percentile speed on the approach to the school zone and at the school zone, Woy Woy South Public School, southbound (combined directions in school zone)

2.4.9 Our Lady of the Rosary Primary School

The 85th percentile speeds at the school zones decreased at the immediate follow-up surveys (by 4 km/h), and reductions continued for the three-month follow-up survey. On the approaches, small reductions were experienced at the immediate follow-up survey, however, there was a slight increase in 85th percentile speeds for the northbound three-month follow-up survey, while southbound remained stable. Speeds at all survey locations reduced at the 12-month survey to their lowest levels for the evaluation and were well below baseline levels everywhere except the southbound approach.

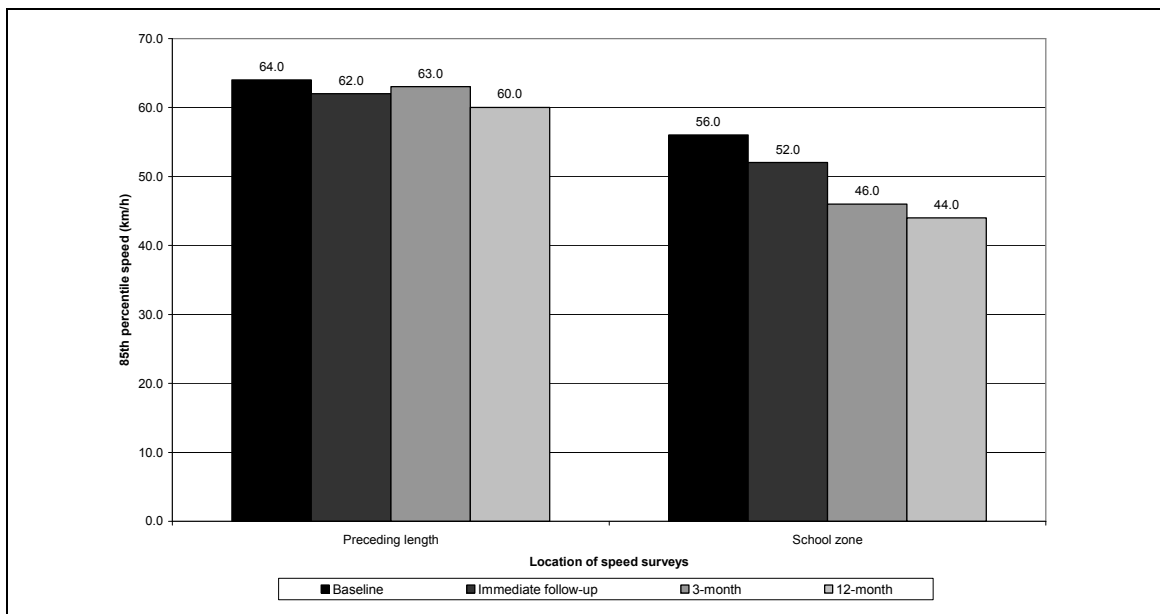


Figure 31: 85th percentile speed on the approach to the school zone and at the school zone, Our Lady of the Rosary Primary School, northbound (combined directions at school zone)

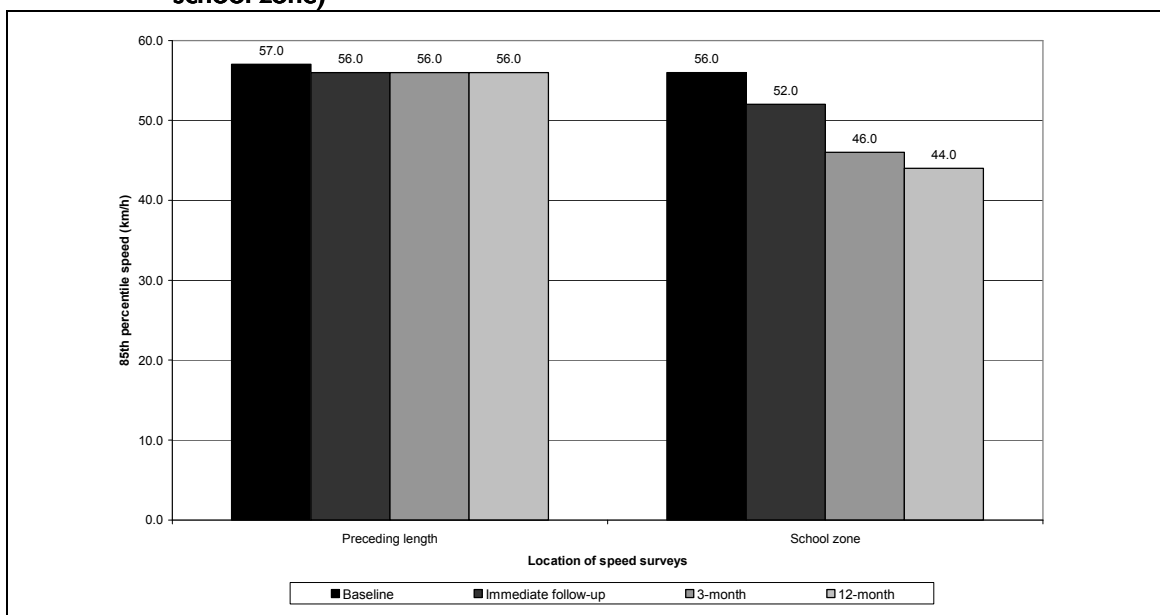


Figure 32: 85th percentile speed on the approach to the school zone and at the school zone, Our Lady of the Rosary Primary School, southbound (combined directions at school zone)

2.4.10 Ourimbah Public School

Speeds in the school zone (combined directions) and on the southbound approach experienced reductions at the immediate follow-up surveys. These reductions continued for the three-month follow-up surveys. The northbound approach showed an increase in 85th percentile speeds immediately after the camera commenced issuing infringement notices. Although a reduction was experienced after three months, the 85th percentile speed at this time remained slightly higher than that observed for the baseline survey. After 12 months, speeds had reduced substantially at the school zone locations to well below baseline level, but less substantially on the southbound approach. The northbound approach saw a small increase above baseline levels at 3 months and 12 months.

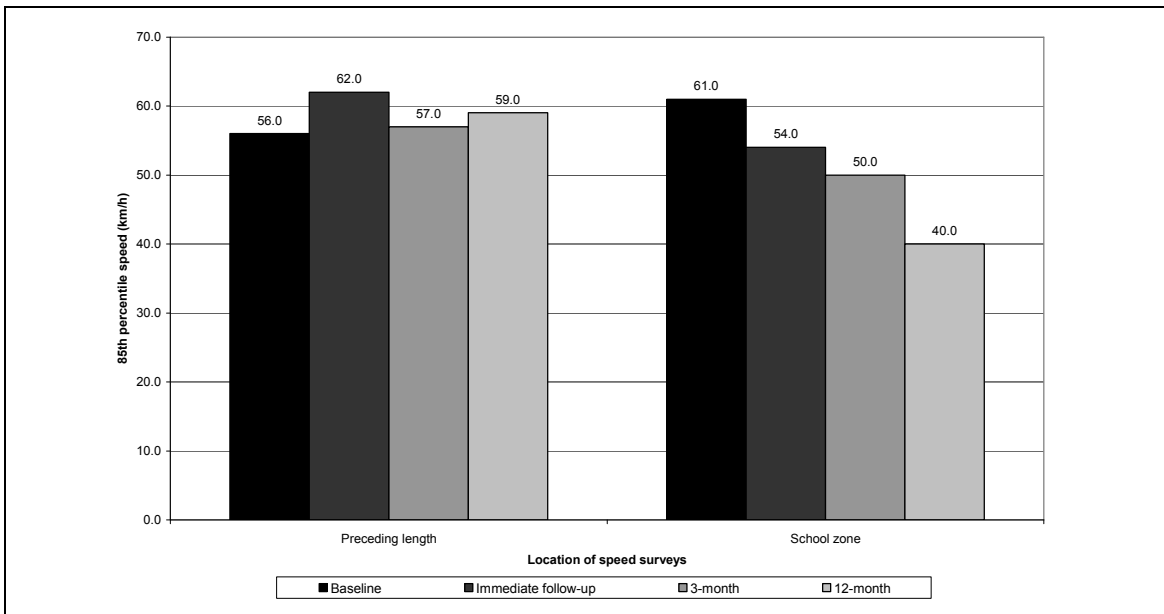


Figure 33: 85th percentile speed on the approach to the school zone and at the school zone, Ourimbah Public School School, northbound (combined directions in school zone)

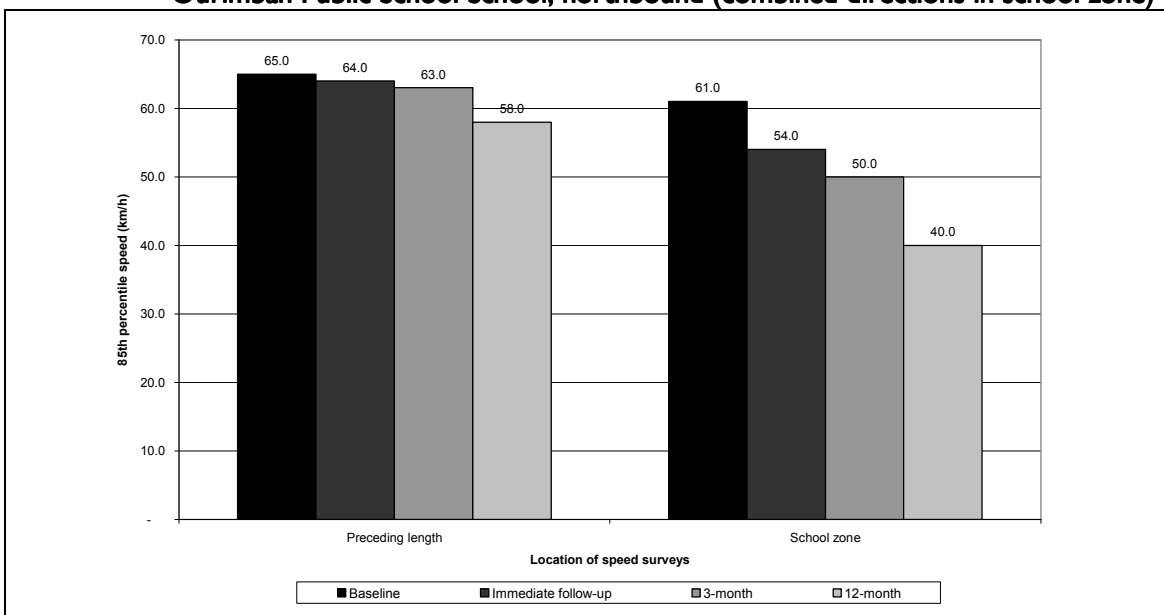


Figure 34: 85th percentile speed on the approach to the school zone and at the school zone, Ourimbah Public School, southbound (combined directions in school zone)

2.5 Recorded data by site on approaches to the school speed zone

Tables 12 to 14 show the recorded speed results for all vehicles on the approaches to the 40 km/h school speed zone across all sites. Speeds were recorded in one direction on each approach to each school zone (except Middle Harbour and Fairy Meadow, where data for only one approach were collected), and the directions are shown in the same order that the school zone figures were shown in Tables 2 to 4 (Section 2.2.1). Therefore, for example, vehicles travelling northbound through the approach to St Patrick's Primary School would then travel northbound through that site's speed camera.

These tables show that speeds and speeding rates decreased across the approaches to nearly all of the treatment sites by the end of the 12-month evaluation. Slight reductions were also apparent at most of the control sites. Percentages exceeding the speed limit by 10 or 20 km/h began at fairly low levels and still decreased during the 12-month evaluation period.

Note that these tables show approaches to school zones. The approaches are not subject to the school zone speed limit of 40 km/h and consequently the percentages of vehicles exceeding the limit by various amounts in these tables refer to vehicles exceeding the non-school zone limit (50 or 60 km/h, depending on the site).

Control site data are presented in the lower section of each table. Section 2.5.1 uses these control data to discuss whether the speed and speeding rate reductions can be attributed to the fixed digital speed cameras.

Table 12: Recorded mean and 85th percentile speeds for all speed camera sites, all vehicles, on the approaches to the school zone

School	Direction	Mean speed (km/h)				85 th percentile speed (km/h)			
		Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'	Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'
Treatment sites									
Middle Harbour PS ^{**} (only one approach)	N	47.5	43.4	43.8	44.0	54.5	50.5	50.5	49.0
St Patrick's PS	N	47.7	46.3	58.2	40.6	62.0	60.5	67.5	56.5
	S	51.3	51.1	56.4	50.1	62.0	60.5	66.0	59.5
St Catherine Laboure PS	E	60.3	51.9	52.0	53.7	69.5	63.5	64.5	66.0
	W	59.5	58.3	57.7	58.8	67.5	65.0	64.5	65.5
Epping West PS	E	59.8	57.2	57.0	58.0	67.5	64.0	63.5	64.5
	W	63.2	57.1	58.0	56.9	71.0	64.0	65.0	66.0
Illawarra Grammar [*]	N	50.7	50.8	49.3	52.1	61.0	60.5	58.5	62.0
	S	54.1	51.8	51.8	51.0	65.0	61.0	63.0	62.5
Fairy Meadow DS (only one approach)	E	57.3	48.1	52.9	51.5	63.5	55.0	60.0	58.5
Woy Woy PS	E	46.1	50.0	40.7	45.4	52.5	55.5	46.0	52.0
	W	49.5	47.8	49.3	40.2	55.0	54.0	55.0	46.0
Woy Woy South PS	N		57.0	53.8	53.4		63.0	59.0	59.0
	S	55.2	54.1	53.6	53.5	60.5	58.5	58.0	58.0
Our Lady of the Rosary PS	N	57.6	55.8	56.5	53.9	64.0	62.0	62.5	59.5
	S	50.1	49.4	48.8	49.2	56.9	56.0	56.0	55.5
Ourimbah PS	N	49.2	53.8	50.5	51.6	56.0	61.5	57.0	59.0
	S	55.3	56.2	52.6	51.5	65.0	64.0	63.0	58.0
Control sites									
Lindfield PS (control for St Patrick's PS)		56.1	55.8	55.7	54.8	64.3	63.5	63.3	62.3
Croydon Park PS (control for St Catherine Laboure PS)		54.7	52.8	53.9	53.8	63.6	61.8	62.3	62.8
Kellyville PS (control for Epping West PS)		62.5	62.0	60.4	57.8	71.0	71.5	69.5	67.8
St John Vianney's (control for Fairy Meadow PS)		48.2	48.4	48.3	48.1	54.5	55.0	55.0	54.0
Adamstown PS (control for Woy Woy PS)		48.7	49.6	49.1	48.7	54.8	55.8	57.0	54.8
Charlestown East PS (control for Woy Woy South PS)		58.9	57.5	58.7	57.1	65.0	64.3	65.0	63.3
Niagara Park PS (control for Our Lady of the Rosary PS)		60.3	60.4	60.1	59.7	67.3	67.3	67.1	66.3
Cardiff PS (control for Ourimbah PS)		52.0	53.6	51.5	52.2	60.8	62.8	59.8	61.0

* No control schools were available for Middle Harbour Public School and Illawarra Grammar School

+ Middle Harbour PS was the only site with a 50 km/h non-school hours limit. All other sites had a 60 km/h limit.

Table 13: Recorded percentages of vehicles travelling over the speed limit and more than 10 km/h over the limit for all speed camera sites, all vehicles, on the approaches to the school zone

School	Direction	% travelling above speed limit				% more than 10 km/h over limit			
		Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'	Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'
Treatment sites									
Middle Harbour PS*+	N	0.4	0.1	0.1	0.0	4.3	1.3	1.1	0.7
St Patrick's PS	N	19.0	15.0	42.0	7.8	4.1	2.4	12.4	0.9
	S	18.3	15.8	35.6	13.4	3.4	2.5	7.9	2.3
St Catherine Laboure PS	E	57.5	24.9	29.2	34.1	16.2	3.5	5.7	7.0
	W	52.7	37.1	36.7	41.5	10.5	4.5	3.8	5.3
Epping West PS	E	46.5	29.3	28.3	34.3	9.5	4.1	3.6	5.0
	W	66.1	30.3	34.0	35.4	19.0	4.7	5.8	8.1
Illawarra Grammar*	N	16.1	14.1	9.6	19.0	2.0	1.8	1.1	3.0
	S	31.0	17.8	23.7	21.2	6.2	2.0	4.0	3.3
Fairy Meadow DS (only one approach)	E	26.1	2.4	14.1	9.8	2.9	0.2	1.2	1.0
Woy Woy PS	E	1.6	2.3	0.1	1.1	0.3	0.3	0.0	0.0
	W	2.2	1.6	2.6	0.0	0.0	0.0	0.1	0.0
Woy Woy South PS	N		28.6	11.0	8.5		2.0	0.5	0.4
	S	14.6	8.1	6.3	6.8	0.5	0.2	0.1	0.1
Our Lady of the Rosary PS	N	30.7	22.0	23.9	12.2	3.1	2.2	1.5	1.0
	S	5.2	4.4	4.7	3.6	0.4	0.3	0.4	0.3
Ourimbah PS	N	4.3	17.5	5.7	8.5	0.1	1.4	0.2	0.3
	S	34.2	29.3	26.3	6.4	4.0	3.1	2.4	0.0
Control sites									
Lindfield PS (control for St Patrick's PS)		19.9	15.4	19.8	11.6	2.7	1.9	2.6	1.0
Croydon Park PS (control for St Catherine Laboure PS)		4.4	3.8	2.7	2.9	0.7	0.6	0.3	0.3
Kellyville PS (control for Epping West PS)		31.0	16.3	19.4	17.8	6.8	3.1	3.5	3.8
St John Vianney's (control for Fairy Meadow PS)		4.7	3.8	5.2	2.2	0.7	0.5	0.5	0.2
Adamstown PS (control for Woy Woy PS)		5.4	6.6	4.8	4.1	0.4	0.4	0.3	0.4
Charlestown East PS (control for Woy Woy South PS)		16.0	23.4	16.0	10.1	1.7	3.0	1.5	0.8
Niagara Park PS (control for Our Lady of the Rosary PS)		4.6	1.7	2.7	2.7	0.3	0.1	0.1	0.1
Cardiff PS (control for Ourimbah PS)		15.3	19.7	9.6	9.6	2.5	2.3	0.9	1.0

* No control schools were available for Middle Harbour Public School and Illawarra Grammar School

+ Middle Harbour PS was the only site with a 50 km/h non-school hours limit. All other sites had a 60 km/h limit.

Table 14: Recorded percentages of vehicles more than 20 km/h over the limit for all speed camera sites, all vehicles, on the approaches to the school zone

School	Direction	% more than 20 km/h over limit			
		Baseline 'before'	Just 'after'	3-month 'after'	12-month 'after'
Treatment sites					
Middle Harbour PS ⁺	N	0.4	0.1	0.1	0.0
St Patrick's PS	N	0.4	0.4	1.7	0.1
	S	0.3	0.3	0.9	0.2
St Catherine Laboure PS	E	1.5	0.3	0.4	0.4
	W	0.8	0.2	0.3	0.3
Epping West PS	E	0.8	0.3	0.3	0.4
	W	2.5	0.6	0.6	0.9
Illawarra Grammar	N	0.1	0.1	0.2	0.5
	S	0.5	0.2	0.4	0.3
Fairy Meadow DS	E	0.3	0.0	0.1	0.0
Woy Woy PS	E	0.1	0.0	0.0	0.0
	W	0.0	0.0	0.0	0.0
Woy Woy South PS	N		0.0	0.0	0.0
	S	0.0	0.0	0.0	0.0
Our Lady of the Rosary PS	N	0.2	0.0	0.1	0.1
	S	0.0	0.0	0.0	0.1
Ourimbah PS	N	0.0	0.1	0.0	0.0
	S	0.0	0.2	0.1	0.0
Control sites					
Lindfield PS (control for St Patrick's PS)		0.2	0.3	0.2	0.1
Croydon Park PS (control for St Catherine Laboure PS)		1.5	0.3	0.4	0.5
Kellyville PS (control for Epping West PS)		1.2	5.3	4.4	2.5
St John Vianney's (control for Fairy Meadow PS)		0.0	0.0	0.0	0.0
Adamstown PS (control for Woy Woy PS)		0.3	0.0	0.0	0.0
Charlestown East PS (control for Woy Woy South PS)		0.3	0.2	0.3	0.2
Niagara Park PS (control for Our Lady of the Rosary PS)		0.5	0.8	0.6	0.5
Cardiff PS (control for Ourimbah PS)		0.3	0.3	0.4	0.2

* No control schools were available for Middle Harbour Public School and Illawarra Grammar School

+ Middle Harbour PS was the only site with a 50 km/h non-school hours limit. All other sites had a 60 km/h limit.

2.5.1 Overall comparisons by speed zone within the 40 km/h speed zone – all vehicles, approaches to the school zones

Tables 15 to 17 describe the speed characteristics during each series of speed surveys for all vehicles in the approaches to all camera sites.

It should be noted that the number of sites in each speed zone varies:

- 50 km/h – 1 camera site (no control site).
- 60 km/h – 9 camera sites and 8 control sites.

Table 15 contains data from the approaches to the school speed zones that are zoned 60 km/h outside school zone hours. Note, however, that the approach lengths are zoned 60 km/h at all times.

Table 16 presents data from the approach to the site that is zoned 50 km/h outside school zone hours and has no control site. Note that the approach length is zoned 50 km/h at all times.

Table 17 presents data from the approach to the site that is zoned 60 km/h outside school zone hours and has no control site. Again, this approach is zoned at 60 km/h at all times.

There were small overall reductions in mean speeds and 85th percentile speeds, while the percentage of vehicles exceeding the speed limit across all speed zones between the baseline and follow-up speed surveys reduced by relatively large proportions. These large reductions are partly due to substantial increases in speeding rates on the approaches to some control sites.

The reductions identified are associated with the speed camera treatments and the discussion on control ratios in Section 2.2.3 describes how the association was determined.

Table 15: Speed characteristics for the eight speed camera sites with controls (40 km/h in school zone times, 60 km/h other times) – all vehicles, on the approaches to the school zones

Speed characteristics	Baseline 'before' (km/h)	Just 'after'					3-month 'after'					12-month 'after'				
		Control ratio	Expected (km/h)	Actual (km/h)	Diff. (km/h)	%	Control ratio	Expected (km/h)	Actual (km/h)	Diff. (km/h)	%	Control ratio	Expected (km/h)	Actual (km/h)	Diff. (km/h)	%
	①	②	③=①×②	④	⑤=④-③	⑤/③×100	②	③=①×②	④	⑤=④-③	⑤/③×100	②	③=①×②	④	⑤=④-③	⑤/③×100
Mean speed, \bar{x} (km/h)	53.1	1.00	52.9	52.1	-0.8	-1.5	0.99	52.7	52.2	-0.5	-0.8	0.98	52.0	50.4	-1.6	-3.1
85 th percentile speed, P ⁸⁵ (km/h)	61.5	1.00	61.5	60.0	-1.5	-2.4	1.00	61.2	60.0	-1.2	-1.9	0.98	60.3	58.5	-1.8	-3.1
Percentage above speed limit	22.4	0.88	19.6	16.1	-3.5	-18.1	0.87	19.4	18.1	-1.3	-6.7	0.76	16.9	12.9	-4.0	-23.6
Percentage more than 10 km/h above speed limit	3.8	1.09	4.2	1.8	-2.4	-57.7	0.93	3.6	2.7	-0.9	-23.2	0.66	2.5	1.7	-0.8	-33.8
Percentage more than 20 km/h above speed limit	0.3	1.70	0.5	0.1	-0.4	-78.0	1.48	0.4	0.3	-0.1	-35.9	0.94	0.3	0.1	-0.2	-52.6

Table 16: Speed characteristics for the single 40 km/h school zone speed camera site, without a control site, that is zoned 50 km/h outside school zone hours – all vehicles, on the approaches to the school zone

Speed characteristics	Baseline 'before' (km/h)	Just 'after' (km/h)	3-month 'after' (km/h)	12-month 'after' (km/h)	Baseline – just 'after'		Baseline – 3-month 'after'		Baseline – 12-month 'after'	
					km/h	%	km/h	%	km/h	%
	①	②	③	④	⑤=②-①	⑥=⑤/①×100	⑦=③-①	⑧=⑦/①×100	⑨=④-①	⑩/①×100
Mean speed, \bar{x} (km/h)	47.5	43.4	43.8	44.0	-4.1	-8.5	-3.7	-7.8	-3.5	-7.3
85 th percentile speed, P ⁸⁵ (km/h)	54.5	50.5	50.5	49.0	-4.0	-7.3	-4.0	-7.3	-5.5	-10.1
Percentage above speed limit	36.1	14.6	16.4	9.4	-21.5	-59.6	-19.7	-54.7	-26.7	-73.9
Percentage more than 10 km/h above speed limit	4.3	1.3	1.1	0.7	-3.0	-70.0	-3.2	-73.6	-3.6	-82.9
Percentage more than 20 km/h above speed limit	0.4	0.1	0.1	0.0	-0.3	-75.0	-0.3	-75.0	-0.4	-100.0

Table 17: Speed characteristics for the single 40 km/h school zone speed camera site, without a control site, that is zoned 60 km/h outside school zone hours – all vehicles, on the approaches to the school zone

Speed characteristics	Baseline 'before' (km/h)	Just 'after' (km/h)	3-month 'after' (km/h)	12-month 'after' (km/h)	Baseline – just 'after'		Baseline – 3-month 'after'		Baseline – 12-month 'after'	
					km/h	%	km/h	%	km/h	%
	①	②	③	④	⑤=②-①	⑤/①×100	⑦=③-①	⑦/①×100	⑨=④-①	⑨/①×100
Mean speed, \bar{x} (km/h)	61.5	57.2	57.5	57.5	-4.3	-7.0	-4.0	-6.5	-4.0	-6.5
85 th percentile speed, P ⁸⁵ (km/h)	69.3	64.0	64.3	65.3	-5.3	-7.6	-5.0	-7.2	-4.0	-5.8
Percentage above speed limit	56.3	29.8	31.1	34.8	-26.5	-47.1	-25.2	-44.7	-21.5	-38.2
Percentage more than 10 km/h above speed limit	14.3	4.4	4.7	6.6	-9.9	-69.2	-9.6	-67.0	-7.7	-53.9
Percentage more than 20 km/h above speed limit	1.6	0.5	0.5	0.6	-1.2	-72.0	-1.2	-70.5	-1.0	-62.7

3 Key findings

Types of Zones

There were three types of zones:

- Type A - eight were 40 km/h school speed zones **with controls** (60 km/h during all other times)
- Type B - one was a 40 km/h school speed zone, **without a control**, (zoned 50 km/h during all other times)
- Type C - one was a 40 km/h school speed zone, **without a control**, (zoned 60 km/h during all other times).

Key findings

The statistical analysis provides clear evidence of the immediate and sustained impact of the cameras in reducing speeds in the school zones. These reductions were apparent on all six indicators used including the higher vehicle speeds. There was a smaller but still beneficial impact on speeds on the approaches to the zones. In summary:

I. At the school zones, after 12 months

- mean speeds had reduced by
 - Type A - 9.6 km/h (21.6%)
 - Type B - 6.0 km/h (14.0%)
 - Type C - 15.5 km/h (29.8%).
- the 85th percentile speeds had reduced by:
 - Type A - 13.9 km/h (25.7%)
 - Type B - 8.8 km/h (17.2%)
 - Type C - 21.1 km/h (33.6%).
- the percentage of vehicles exceeding the speed limit had reduced from:
 - Type A - 76.1% to 15.0%
 - Type B - 65.1% to 21.5%
 - Type C - 84.9% to 19.0%.
- the percentage of vehicles exceeding the speed limit by more than 10 km/h had reduced from:
 - Type A - 39.4% to 2.1%
 - Type B - 16.6% to 2.4%
 - Type C - 59.3% to 4.8%.
- the percentage of vehicles exceeding the speed limit by more than 20 km/h had reduced from:
 - Type A - 8.9% to 0.2%
 - Type B - 1.8% to 0.2%
 - Type C - 21.8% to 0.5%.

- the percentage of vehicles exceeding the speed limit by more than 30 km/h reduced from:

Type A – 1.1% to zero

Type B – 0.1% to zero

Type C – 3.4% to zero.

2. On the approaches to the school zones, after 12 months

- mean speeds had reduced by
 - Type A – 1.6 km/h (3.1%)
 - Type B – 3.5 km/h (7.3%)
 - Type C – 4.0 km/h (6.5%).
- the 85th percentile speeds had reduced by:
 - Type A – 1.8 km/h (3.1%)
 - Type B – 5.5 km/h (10.1%)
 - Type C – 4.0 km/h (5.8%).
- the percentage of vehicles exceeding the speed limit had reduced from:
 - Type A – 22.4% to 12.9%
 - Type B – 36.1% to 9.4%
 - Type C – 56.3% to 34.8%.
- the percentage of vehicles exceeding the speed limit by more than 10 km/h had reduced from:
 - Type A – 3.8% to 1.7%
 - Type B – 4.3% to 0.7%
 - Type C – 14.3% to 6.6%.
- the percentage of vehicles exceeding the speed limit by more than 20 km/h had reduced from:
 - Type A – 0.3% to 0.1%
 - Type B – 0.4% to 0.0%
 - Type C – 1.6% to 0.6%.

3. Heavy vehicles in the school zones

Heavy vehicle speeds and speeding rates decreased across all treatment sites by the end of the 12 month evaluation period. This is consistent with the trends noted across all vehicles, although the speeds and speeding rates among heavy vehicles were lower than those for all vehicles.

4 Conclusions

The speed survey data reveal that the speed cameras had a pronounced effect on driver behaviour in terms of reduced speeding at school zones. Overall, reductions have been observed in traffic speeds and the percentage of vehicles exceeding the speed limit and these reductions have been maintained or improved after 12 months of speed camera operation.

Vehicle speeds and speeding rates on the lengths of road approaching the school zones with speed cameras (the 'approach lengths') also reduced, although the reductions were not as substantial, with speed reductions generally less than 10 per cent. In some cases however, the proportion of vehicles exceeding the speed limit in these approach lengths dropped by more than 30 per cent in both directions (that is, on both approaches to the school zone). These reductions take into account the activity at control sites and therefore can be attributed to the presence of the fixed digital speed cameras.

These speed reductions achieved on approaches to school zones suggest that drivers are indeed aware of the presence of the cameras and are slowing down in readiness for the school zone in areas where they would not have slowed down in the past.

Heavy vehicle 85th percentile speeds have reduced to below the 40 km/h speed limit at most sites and the proportions of heavy vehicles exceeding the speed limit have dropped substantially. Note however, that control site heavy vehicle figures have not been compared with treatment site figures.