



**MONASH** University  
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**OUTCOME EVALUATION OF THE  
EFFECTIVENESS OF THE SAFE  
ROUTES TO SCHOOLS PROGRAM**

by

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**Title and sub-title:** Outcome Evaluation of the Effectiveness of the Safe Routes to Schools Program

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**Abstract:**

The Safe Routes to Schools (SRTS) community based road safety program has operated in primary schools throughout Victoria since 1990. The program includes education, engineering, encouragement and enforcement initiatives, aimed principally at reducing casualty crash frequency and severity for children as pedestrians, bicyclists and passengers. This paper describes the methodology and results of an evaluation of the crash effects of the Safe Routes to Schools program in Victoria.

The evaluation examines the crash effects associated with the program across a number of road user groups at all times of day and at the times at which children are likely to be travelling to and from school. The analysis was conducted using a quasi-experimental, before and after, treatment and control design. The treatment areas were defined by the postcode areas surrounding the treatment schools and control areas were defined as all other postcode areas within the same Local Government Areas (LGAs) as the treated schools.

The results of the analyses indicate that the estimated average yearly net effect of the program over the post-implementation period was beneficial in safety terms. The largest percentage reduction in casualty crashes was identified for primary school-aged pedestrians and bicyclists travelling during school travel times only (17.9%). Crashes involving primary school-aged pedestrians and bicyclists at all times, and crashes involving primary school-aged children at all times, were estimated to have fallen by 12.6 and 12.7 percent respectively. In addition, a 4.8 percent reduction in crashes involving all road users at school travel times was identified. Attempts to estimate the effect of the program in each year following the implementation of the program were statistically inconclusive, most likely because of insufficient data. In respect of the severity of crashes involving the relevant road users, no statistically reliable reductions in fatal and serious injury crash frequency could be identified at the five-percent level.

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**Key Words:**

Safe Routes to Schools, pedestrian safety, outcome evaluation

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# Preface

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The authors of this report would like to sincerely thank and acknowledge the valuable contribution of VicRoads, particularly Linda Ivett, Barry Scott and Russell Greenland, in the completion and funding of this project.

Further, readers are referred to a related behavioural study of the SRTS program conducted by ARRB Transport Research Ltd (Cairney, 2003). This report details a behavioural study involving a quasi-experimental comparison between SRTS schools and Comparison schools. The study consisted of behavioural observations, interviews with principals, a road safety quiz for students and a parental questionnaire. The study concludes that the effectiveness of SRTS programs evaluated in the project depends on a combination of changes to the physical infrastructure and mobilising parents to address road safety issues as they affect their children. Recommendations arising from the behavioural study include continuing provision of physical infrastructure as a key element of the program, reinforcing the role of parents/carers, improving the way the “STOP, LOOK, LISTEN, THINK” message is taught, and ensuring that any future behavioural studies were before-after studies comparing changes in behaviour at the same sites.



# TABLE OF CONTENTS

<b>1.0</b>	<b>INTRODUCTION.....</b>	<b>1</b>
1.1.	BACKGROUND TO THE SAFE ROUTES TO SCHOOLS PROGRAM.....	1
1.2.	STUDY AIM.....	1
<b>2.0</b>	<b>EVALUATION DESIGN.....</b>	<b>2</b>
2.1.	HYPOTHESES.....	2
2.2.	STUDY DESIGN.....	2
<b>3.0</b>	<b>DATA.....</b>	<b>7</b>
<b>4.0</b>	<b>METHODOLOGY.....</b>	<b>8</b>
4.1.	AGGREGATE ANALYSIS.....	8
4.2.	YEAR-BY-YEAR ANALYSIS.....	9
<b>5.0</b>	<b>RESULTS.....</b>	<b>10</b>
5.1.	OVERALL PROGRAM EFFECTS.....	10
5.1.1.	<i>Crash Savings.....</i>	<i>11</i>
5.2.	YEAR-BY-YEAR ANALYSIS.....	12
5.2.1.	<i>All road users.....</i>	<i>12</i>
5.2.2.	<i>Primary school-aged children.....</i>	<i>13</i>
5.2.3.	<i>Primary school-aged pedestrians and bicyclists.....</i>	<i>13</i>
5.2.4.	<i>Program Density Effects.....</i>	<i>14</i>
5.3.	CRASH SEVERITY.....	14
<b>6.0</b>	<b>DISCUSSION.....</b>	<b>16</b>
<b>7.0</b>	<b>CONCLUSION.....</b>	<b>19</b>
<b>8.0</b>	<b>LIMITATIONS AND ASSUMPTIONS.....</b>	<b>20</b>
<b>9.0</b>	<b>REFERENCES.....</b>	<b>20</b>
	<b>APPENDIX A.....</b>	<b>21</b>
	<b>SCHOOLS INVOLVED IN THE SRTS PROGRAM.....</b>	<b>21</b>
	<i>Table 1: Details of Schools Involved in the SRTS Program.....</i>	<i>23</i>
	<b>APPENDIX B.....</b>	<b>27</b>
	<b>POSTCODE AND LGAs IN EACH CLUSTER.....</b>	<b>27</b>
	<i>Table 1. Treatment Postcodes and LGAs.....</i>	<i>29</i>



## EXECUTIVE SUMMARY

This report describes the results of an evaluation of effects on crashes of the Safe Routes to Schools community based road safety program in Victoria. The program has operated largely in primary schools throughout Victoria since 1990 and includes education, engineering, encouragement and enforcement initiatives. The principal objective was to reduce casualty crash frequency and severity for children as pedestrians, bicyclists and passengers. However, there was some expectation that effects may extend beyond these road users.

This evaluation examines the crash effects associated with the program across a number of road user groups at all times of day as well as at the times at which children are likely to be travelling to and from school. The analysis was conducted using a quasi-experimental, before and after, treatment and control design. The treatment areas were defined by the postcode areas surrounding the treatment schools and control areas were defined as all other postcode areas within the same Local Government Areas (LGAs) as the treated schools.

Primary school-aged children were defined as those children aged between 5 and 13 years inclusive. School travel times refer to those times of day at which children are likely to travel to and from school. For the purposes of this study these times were defined as 7:30 to 9:30 am and 3:00 to 5:00 pm on weekdays.

The results of the analyses indicate that the estimated average yearly net effect of the program over the post-implementation period was beneficial in safety terms. The largest percentage reduction in casualty crashes was identified for primary school-aged pedestrians and bicyclists travelling during school travel times only (17.9%). Crashes involving primary school-aged pedestrians and bicyclists at all times, and crashes involving primary school-aged children at all times, were estimated to have fallen by 12.6 and 12.7 percent respectively. In addition, a 4.8 percent reduction in crashes involving all road users at school travel times was identified. These results were statistically reliable at the 95% level of confidence. Attempts to estimate the effect of the program in each year following the implementation of the program were statistically inconclusive, most likely because of insufficient data.

The evaluation also examined the impact of the program on the severity of crashes involving the relevant road users. No statistically reliable reductions in fatal and serious injury crashes frequency could be identified at the five-percent level. Further, the magnitude of the reductions in fatal and serious casualty crash frequency was equal to, and in most cases less than, the magnitude of overall reductions in casualty crash frequency. This suggests that these reductions may reflect the reductions in total casualty crash frequency rather than a genuine decrease in the frequency of fatal and serious crashes. Therefore, the results of the analysis by severity level should be viewed with caution.

Overall the Safe Routes to Schools Program is assessed to have had a beneficial effect on safety. The primary target group, *primary school-aged children*, were involved in some 12-18 percent fewer casualty crashes, depending upon the specific times and/or travel modes considered. Further, all road users were estimated to have been involved in 4.8 percent fewer casualty crashes during the defined travel times.



## **1.0 INTRODUCTION**

### **1.1. BACKGROUND TO THE SAFE ROUTES TO SCHOOLS PROGRAM**

The Safe Routes to Schools road safety program (SRTS) was introduced to Victoria in the early 1990s in response to the VicRoads Pedestrian Accident Project which highlighted the particular vulnerability of children as road users. The SRTS program is a community-based road safety program “designed to reduce the incidence and severity of injuries to school-age children as pedestrians, bicyclists and passengers from Prep to Year 10” (VicRoads, 2000). In general, the program involves the investigation of the issues and needs of each school undertaking the program using tools such as local observational and travel surveys and on-site investigations of road user behaviour. After identifying the most common routes taken to and from school, a road safety action plan is then developed detailing the education, engineering, encouragement and, where appropriate, enforcement interventions required to address the road safety issues specific to the school. The school and the local municipality then implement this plan. It is intended that this process achieve the following five objectives:

1. Establish a partnership between municipalities, VicRoads and school communities, including teachers and parents, in implementing a multi-action road safety intervention program for children and young people
2. Identify the specific road safety problems for children and young people along major routes in the local area used to travel to and from school
3. Develop, implement, maintain and evaluate appropriate education, engineering, encouragement and enforcement interventions that address the road safety problems for children and young people travelling to and from school
4. Raise awareness among young people and their parents/carers about road safety issues in the local community.
5. Encourage, where appropriate, more children and young people, and their parents/carers, to walk or cycle to or from school using the safest routes.

### **1.2. STUDY AIM**

It was the purpose of this study to examine the actual effect, if any, of the SRTS program on the involvement of primary school-aged children in reported casualty crashes en-route to school and the severity of such crashes. Further, the study aimed to investigate the broader effects of the program in time and road user groups beyond those targeted by the program. Changes in the effect of the program over time and the relationship of these changes to the implementation and density of operation of the program were also investigated.

## **2.0 EVALUATION DESIGN**

### **2.1. HYPOTHESES**

Consistent with the aim of the study, the evaluation examined two distinct hypotheses. First, the effect of the SRTS program on casualty crash frequency in the defined treatment areas is examined across a number of road user groups and times of day. More formally, this involves testing the null hypothesis that the SRTS program is not associated with any casualty crash reductions in the treatment areas against the alternative hypothesis that the SRTS program has led to changes in the casualty crash frequency in the treatment areas.

Second, the effect of the SRTS program on the severity of casualty crashes occurring at different times of day and across a number of road user groups in the treatment areas is evaluated. In particular, the null hypothesis that the SRTS program is not associated with reductions in casualty crash severity in the treatment areas is tested against the alternative hypothesis that the SRTS program was associated with reductions in casualty crash severity in the treatment areas. Both of these general hypotheses are tested with respect to crashes involving three road user groups: all road users, primary school-aged children and primary school-aged pedestrians and bicyclists. Further, each of the hypotheses is tested for crashes occurring at all times of day and during school travel times only thereby creating six road user groups/sub-groups.

### **2.2. STUDY DESIGN**

The evaluation of the effect of the SRTS program is conducted using a quasi-experimental treatment-control design. This approach compares casualty crash frequency or severity in the areas expected to be influenced by the program with casualty crash frequency or severity in the control areas before and after the implementation of the program. In doing so, real changes in the levels of road trauma associated with the introduction of the treatment at treatment sites can be identified by allowing trends related to factors other than the implementation of the SRTS program to be represented in the control areas. When appropriate treatment and control areas are defined, the difference in casualty crash frequency between the two areas will represent the effect of the SRTS program.

#### *Treatment and Control Areas*

In adopting this approach it is necessary to give careful consideration to the selection of the treatment and control areas. First, the expected influence of the SRTS program in geographic terms must be identified. As the SRTS program aims to improve road safety for children travelling to and from school the effect of the program is expected to be greatest on the routes travelled by children to and from schools involved in the program. Ideally, each of these routes would be identified and classified as falling within the treatment areas. However, the crash data systems available do not allow such specific targeting. Further, it is not possible to gather the required information about individual students attending the schools in which the program is run to target only crashes involving these students.

An alternative and more practical approach is to define the treatment area using the postcodes of the treatment schools and the areas immediately surrounding them. Given the focus of the program on pedestrians and bicyclists the effects of the SRTS program are expected to be concentrated in the geographical area around the treatment schools as primary school-aged children using these modes of transport are unlikely to travel long distances to and from school. Therefore, it is expected that the use of postcodes to define the treatment areas will enable the effects of the SRTS program to be identified in the areas most likely to be influenced by the program. The postcodes of the treatment schools were all selected as treatment postcodes. In addition, where areas outside these postcodes were within reasonable walking or bicycling distance from the school, the postcodes of these areas were also selected as treatment postcodes. It is noted that the selection of these areas was conducted by visual inspection of the Melbourne and Victorian street directories.

Having identified the treatment areas surrounding each school it was found that many of the treatment areas overlapped. To streamline the evaluation process, the identified treatment areas were grouped into nineteen geographic clusters. This enables the investigation of the influence of the program when it is run in a number of schools in the same geographic area. It also assists in the identification of the control areas.<sup>1</sup>

In selecting the control areas, it is necessary to match them as closely as possible to the treatment areas in terms of their characteristics. This approach aims to ensure that any changes in casualty crash frequency or severity identified in the treatment areas are associated with the SRTS program rather than some other external co-incidental effect. Road users in the treatment areas who were not targeted by the SRTS program were considered for use as control groups. However, prior to the analysis it was not clear whether the SRTS program would be restricted to particular road user groups, such as primary school-aged pedestrians and bicyclists, or would extend to influence a wider range of road users. If the program effect was broad, the use of this control group would be inappropriate. Therefore, the control areas are defined by the postcodes falling outside the treatment areas but within the same local government area (LGA).

By restricting the control areas to the same LGA as the treatment area, the controls can be matched in time to the operation of the program in a particular geographic area. This is particularly relevant given the staggered introduction of the program. If all non-treatment areas across the state were used as control groups, such matching in time would not be possible. Further, providing sufficient data are available, this approach enables regional differences in the effect of the program to be identified. Finally, the restriction of control areas to the same LGA as the treatment areas is expected to ensure that factors external to the SRTS program are sufficiently similar in the treatment and control areas. However, it is assumed that the control areas will be located far enough from the treatment areas to avoid the effect of the SRTS program. Nevertheless, if the effect of the SRTS program does “spill over” into control areas the estimated effects of the SRTS program should be considered conservative. That is, if the program influences casualty crash frequency in the control areas to any extent, the difference between casualty crash frequency in the treatment and control

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<sup>1</sup> Details of the schools involved in the program is provided in Appendix A whilst the treatment and control postcodes are shown in Appendix B.

areas will be reduced and the estimated effects of the program will be lower than the actual effects.

### *Before and After Periods*

It is also necessary to define the before and after periods of the study. The casualty crash data were divided into before and after groups based on whether collisions took place before or after the first implementation of the SRTS program in the geographic cluster corresponding to the crash site. In addition, collisions occurring in the period after the implementation of the program were further divided on the basis of the number of years since the implementation of the first SRTS program in the relevant cluster. This approach and the reasons for its adoption are detailed below.

The SRTS program has been conducted in a large number of schools throughout Victoria over the past decade. However, each school in Victoria did not commence the program at the same time. Indeed, even within each of the 19 geographic clusters identified, the schools involved in the program did not commence in the same year.<sup>2</sup> Given the staggered introduction of the program, it is not useful to examine the effect of the SRTS program in individual calendar years. Rather, it is preferable to evaluate the effect of the program in each of the years following its implementation. That is, the effect of the program one, two and three years after its introduction is to be determined regardless of the year in which the program commenced. Adopting this approach increases the power of the statistical tests by increasing the number of schools involved in any one year after implementation of the program. Determining the year of implementation is therefore critical to the adoption of this method.

To enable the effect of the program to be evaluated for each cluster on a common basis, the start date of the program was determined individually for each cluster. The start date for an individual cluster is determined by the year in which the program was first introduced in that cluster. For example, the SRTS program was first run in cluster eight in 1990. Therefore, 1990 is identified as year one for this cluster. The following table, demonstrates the way in which the index is assigned for each of the following years in cluster eight.

**Table 1. Cluster Eight.**

<b>Year Commenced</b>	<b>No. of schools commencing in this year</b>	<b>Year Index</b>
1990	10	1
1991	6	2
1997	14	8
1998	3	9

It is evident from the above table that 10 schools commenced the SRTS program in 1990. These schools were the first in this cluster to introduce the program. Therefore, 1990 is determined to be the start year in this cluster and a crash occurring in 1990 in cluster eight would be assigned a 'year index' of 1. In 1991, the SRTS program was in its second year of operation and 6 new schools introduced the program. Therefore, a crash occurring in 1991 in

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<sup>2</sup> A summary table detailing the number of schools commencing each year in the 19 distinct geographic clusters and the associated year indices is provided in Appendix B.

cluster eight would be assigned a 'year index' of 2. A 'year index' of 8 is assigned to the year 1997 as the first SRTS program in this cluster was introduced 7 years previously. Similarly, the final three schools to implement the program in the cluster commenced in 1998. This year is associated with a 'year index' of 9, as the first SRTS program in cluster eight was introduced 8 years previously.

Using the above information it is possible to determine the number of schools in this geographic cluster that are expected to influence casualty crash frequency and severity for each year following the first introduction of the program. It is hypothesised through knowledge of the program and its effects that an individual SRTS program operating in a given school will have an impact on casualty crash frequency and severity for a period of three years commencing at the time the program is introduced. Therefore, the impact of a program commencing in 1990 would be expected to influence casualty crash frequency and severity most significantly in the years 1990, 1991 and 1992. For the purposes of this analysis, the effect of an individual SRTS program is restricted to three years. As explained later in this section, the assumption of a three-year program effect will not influence the estimate of overall program effect. The assumption of a three-year program effect is based on advice from VicRoads. On this basis, the following table detailing the density of operation can be generated for cluster eight.

**Table 2. Cluster Eight: density of operations**

Calendar Year of Commencement	Year of Operation Index										
	1	2	3	4	5	6	7	8	9	10	11
1990	10	10	10								
1991		6	6	6							
1997								14	14	14	
1998									2	2	2
Total	10	16	16	6	0	0	0	14	16	16	2

The ten schools in which the SRTS program was introduced in 1990 are estimated to affect casualty crash frequency uniformly over years one, two and three. The six schools commencing the SRTS program in 1991, are not expected to influence the program until year 2 (i.e. the year in which they commenced the program) and the influence of the program in these schools will extend to year four. Similar interpretations apply to the schools introducing the program in 1997 and 1998. The final row of

Table 2 above provides the total number of schools expected to influence casualty crash frequency and severity in each year in this cluster. It is noted that in years five to seven, the SRTS program was not operating in cluster eight. The effect of this gap in operations is unknown.

The process detailed above for cluster eight must be repeated for each of the remaining 18 geographic clusters. It is noted that in each of the remaining clusters the calendar year corresponding to the year index will not be the same as for cluster eight. For example, the SRTS program was first introduced into schools in cluster eleven in 1992. Therefore, for this cluster, 1992 will be assigned a 'year index' of 1. The effect of the program is expected to extend to year 3, which will correspond to the calendar year 1994. The table detailing the

density of operation generated for cluster eleven is provided below for comparison with Table 2 above.

**Table 3. Cluster Eleven: density of operations**

Calendar Year of Commencement	Year of Operation Index								
	1	2	3	4	5	6	7	8	9
1992	7	7	7						
1993		2	2	2					
1994			9	9	9				
1997						2	2	2	
1998							1	1	1
Total	7	9	18	11	9	2	3	3	1

Having completed this process for each of the geographic clusters it is possible to generate a density of operations relating to the operation of the program across all geographic areas. This is achieved by summing the number of schools involved in the program for each year index across all the geographic clusters. This produces the following table of the density of operation.

**Table 4. Density of operation across all clusters**

Year of Operation Index	1	2	3	4	5	6	7	8	9	10	11
No. of schools	109	133	162	70	75	43	39	40	29	17	4

It is noted that the density of operation appears to decrease over time. However, this reflects the fact that the SRTS program commenced in 1990 in only three of the nineteen geographic clusters. Therefore, over the period under examination (1990 to 2000) it is only in these clusters that eleven years of experience with the program can be accumulated. In addition, whilst many more than five schools ran the program in these clusters, only five were still in operation in the eleventh year based on the assumption that the influence of the program lasts for three years. It is therefore, expected that the annual magnitude of any crash effects associated with the SRTS program will be linked to the density of operation of the program. However, the exact relationship between the density of operation and crash effects is unknown.

The density of operation across all clusters displayed in Table 4 is based on an assumed treatment life of three years. The effect of the treatment is also expected to remain constant throughout the three-year treatment life. The actual effect of the program may not be reflected in these assumptions. If this is the case the estimated effects for each year after the implementation of the program will not correspond to the density of operation. However, the adoption of this assumption will not affect the results of any analysis relating to the average effect of the program over the post-implementation period. Such an analysis is not affected by the program effect extending beyond three years or a variation in program effect over the time in which the program operates, as the data are considered over the entire post-implementation period, which, in most instances, extends beyond three years from the date of implementation.

### *Other Considerations*

Having identified the treatment and control areas and the relevant before and after periods, it is useful to consider the characteristics of the crash types that are expected to be reduced as a result of the SRTS program. First the program is aimed at improving the safety of children as they travel to and from school. It follows that the greatest influence of the program is likely to be in the early mornings as children travel to school and again in the afternoon as they return home. Based on the influence times of the program expected by VicRoads, the analysis that follows defines school travel times as Monday to Friday from 7:30am to 9:30am and 3:00pm to 5:00pm.

The age of the children likely to be affected by the SRTS program is also relevant. As the program focuses on road safety education of primary school aged children, it is expected that the greatest effect of the program will be on children aged between 5 and 13 years. These children will be referred to as primary school-aged children.

## **3.0 DATA**

VicRoads provided the names and locations of all Victorian schools that have implemented the SRTS program since its introduction in 1990. Given the central focus of the program on road safety for children at primary school, all secondary schools that ran the program were excluded from the evaluation. This did not significantly reduce the treatment area, as most secondary schools involved in the program were located close to primary schools running the program. Approximately 300 primary schools remained that were documented as having commenced the full SRTS program since 1990. It is noted that not all schools had completed the program at the time of this evaluation.

The crash data used in this evaluation cover the period from 1987 to 2000 and were extracted from the VicRoads Police reported casualty crash database using the postcode of crash variable. This ensured that a minimum of three years pre-implementation data were available for use. The data were supplied in unit record format and converted to a crash-based file ensuring that all relevant information relating to primary school-aged children involved in individual crashes was retained. Each collision was assigned to the treatment or control areas on the basis of the postcode and LGA of the crash location.

## 4.0 METHODOLOGY

A log-linear model form with poisson error structure, a model form commonly used for modelling crash data series (Bruhning and Ernst, 1985), was used to estimate the effect of the SRTS program on casualty crash frequency and severity. The analysis is conducted in two parts. First, the average effect of the program is estimated using aggregated post-implementation casualty crash data (section 4.1). That is, the average effect of the program after the introduction of the SRTS program is estimated. In contrast, the second stage of the analysis estimates the effects of the program for each year following its introduction. The precise form of the models used are detailed in the following sections.

### 4.1. AGGREGATE ANALYSIS

The poisson log-linear model of the form shown in equation 1 was used to estimate the average effect of the SRTS program using aggregated post-implementation casualty crash frequency. A similar model was used in the evaluation of the Random Road Watch enforcement program in Queensland (Newstead et al, 2001). In that study, the introduction of the treatment was also staggered over time both within and across regions. The methods used here and described in section 2.2 to adjust for the variety of start times are based on those adopted in the study of the Random Road Watch program.

$$\ln(y_{tp}) = \mathbf{a} + \mathbf{b}_t + \mathbf{g}_p + \mathbf{d}_{tp} + \mathbf{e}_{tp} \quad \dots\dots\dots(1)$$

where,

- $y_{tp}$  casualty crash frequency
- $t$  is an indicator for treatment or control area,  
0 = treatment area, 1 = control area
- $p$  is an indicator variable for before and after periods,  
0 = before period, 1 = after period
- $\mathbf{e}_{tp}$  is the cell Poisson error term
- $\mathbf{a}, \mathbf{b}_t, \mathbf{g}_p$  and  $\delta_{tp}$  are parameters of the model

To avoid redundant parameters in the model specified in equation 1 and for ease of interpretation, it is convenient to set  $\delta_{t0} = 0$  for  $t = 0, 1$ . The net effect of the SRTS program on casualty crashes after adjusting for control can therefore be determined using the following equation.

$$\Delta SRTS = \left(1 - \exp(\hat{\mathbf{d}}_{01} - \hat{\mathbf{d}}_{11})\right) \times 100 \quad \dots\dots\dots(2)$$

## 4.2. YEAR-BY-YEAR ANALYSIS

The casualty crash frequency for each year, as defined by the year index, is extracted from the available data and modelled for the treatment and control areas. The form of the poisson log-linear model used is given by equation four.

$$\ln(y_{ty}) = a + b_t + g_y + d_{ty} + e_{ty} \quad \dots\dots\dots(4)$$

where

- $y_{ty}$  is the yearly casualty crash frequency
- $t$  is an indicator for treatment or control area,  
0 = treatment area, 1 = control area
- $y$  is an indicator variable for the year of operation,  
0 = before period,  $y = 1, 2, \dots, 11$
- $e_{ty}$  is the cell Poisson error term
- $a, b_t, g_y$  and  $d_{ty}$  are parameters of the model

Model redundancy is again avoided by setting  $d_{t0} = 0$  for  $t = 0, 1$ . The net effect of the SRTS program on casualty crashes in each year (as defined by the year index) after adjusting for control can therefore be determined using the following equation.

$$\Delta SRTS = (1 - \exp(d_{0y} - d_{1y})) \times 100 \quad \dots\dots\dots(6)$$

where  $y = 1, 2, \dots, 11$ .

## 5.0 RESULTS

The models detailed above were fitted to the casualty crash data over the period 1987 to 2000. Counts of casualty crashes involving each of the six road user groups/sub-groups were extracted from the crash data for this purpose. The estimated effects generated by the aggregate and year-by-year analyses measure the net effect of the SRTS program on casualty crash frequency.

### 5.1. OVERALL PROGRAM EFFECTS

A model of the form described in section 4.1 was fitted to casualty crash data for each of the six road user groups/sub-groups to estimate the effect of the SRTS program on casualty crash frequency. These models did not consider the year in which the effect took place. Therefore, the estimated changes in casualty crash frequency represent the average net effect of the program over the post-implementation period after adjusting for the control. It was expected that this approach would increase the number of crashes under consideration and add to the power of the statistical tests. The results are summarised in Table 5 below.

**Table 5. Estimated net average effect of the SRTS program on casualty crash frequency**

Road User Group/Time	% change in casualty crash frequency	Pr > ChiSq
<i>All road users at all times</i>	No change	0.47
<i>All road users at school travel times only</i>	<b>-4.8</b>	0.00
<i>Primary school-aged road users at all times</i>	No change	0.89
<i>Primary school-aged road users at school travel times only</i>	<b>-12.7</b>	0.03
<i>Primary school-aged pedestrians and bicyclists at all times</i>	<b>-12.6</b>	0.01
<i>Primary school-aged pedestrians and bicyclists at school travel times only</i>	<b>-17.9</b>	0.01

It is evident that the SRTS program was associated with statistically significant reductions in casualty crash frequency across four distinct road user by time sub-groups when testing at the five-percent level of significance. Therefore, it can be stated with 95 percent confidence that the SRTS program was associated with reductions in casualty crash frequency across the following four road user by time sub-groups:

- All road users at school travel times only
- Primary school-aged children at school travel times only
- Primary school-aged pedestrians and bicyclists at all times
- Primary school-aged pedestrians and bicyclists at school travel times only

It is noted that the estimated percentage reductions in casualty crash frequency are greatest for those road user groups targeted by the SRTS program. The size of the reduction decreases as the road user groups become less precisely targeted. The SRTS program was estimated to have had no impact on casualty crashes involving all road users at all times or primary school-aged children at all times. However, these results were not statistically significant.

### 5.1.1. Crash Savings

The statistically significant results above can be translated into an estimate of the average number of actual crashes saved each year as a result of the SRTS program assuming all SRTS regions had been operating simultaneously. The base level of casualty crashes is taken from the treatment areas only, in the years prior to the implementation of the program. However, given the staggered introduction of the SRTS program across Victoria the length of the pre-treatment period varies between geographic clusters. Therefore, the average frequency of casualty crashes was calculated for each cluster individually and then aggregated to determine the average casualty crash frequency in treatment areas prior to the implementation of the SRTS program. The statistically significant estimated casualty crash reductions are then applied to these pre-implementation levels. The results are presented in Table 6 below.

**Table 6. Estimated average annual crash savings resulting from the SRTS program**

Road User Group/Time	Estimated % change in casualty crash frequency	Average yearly pre-treatment crash frequency	Average no. of crashes saved p.a.
<i>All road users at school travel times only</i>	-4.8 <sup>a</sup>	450	22
<i>Primary school-aged road users at school travel times only</i>	-12.7 <sup>a</sup>	37	5
<i>Primary school-aged pedestrians and bicyclists at all times</i>	-12.6 <sup>a</sup>	46	6
<i>Primary school-aged pedestrians and bicyclists at school travel times only</i>	-17.9 <sup>a</sup>	21	4

<sup>a</sup> estimate is significant at the 5% level

The smallest estimated percentage change in casualty crashes is estimated to lead to the greatest number of actual crashes saved. However, given that this road user group includes a large proportion of all road users this result is not unexpected. Further, this saving will incorporate some of the crash savings associated with other road user groups represented within all road users at school travel times. This includes primary school-aged road users at school travel times only and primary school-aged pedestrians and bicyclists at school travel times only. However, the crash saving associated with primary school-aged pedestrians and bicyclist at times outside school travel times would be in addition to the savings associated with all road users at school travel times only. Therefore, the strata analysed are not mutually exclusive nor is each higher level analysis necessarily a subset of the level before.

Meaningful interpretation of the estimated crash savings in the context of the worth of this program in comparison to other road safety programs requires some knowledge of the costs associated with the SRTS program. This is likely to vary significantly from school to school and reliable estimates are currently unavailable. Analysis of the relative costs and benefits associated with the SRTS program would also benefit from an understanding of the contribution of each of the four components of the program (education, engineering, encouragement and enforcement) to the estimated crash savings. This would assist in optimising the benefits of any future program by enabling investment in the components of the

program that produce the greatest benefit relative to cost. This level of detail is beyond the scope of this report; however, it may provide useful information for any future benefit-to-cost analysis or assessment of continued future investment in SRTS against investment in other road safety programs.

## 5.2. YEAR-BY-YEAR ANALYSIS

Given the positive results obtained in the aggregate analysis, a model of the form described in section 0 was fitted to casualty crash data for each of the six road user groups/sub-groups to give estimates of program effectiveness by year. These models estimated the effect of the SRTS program on casualty crash frequency for each year following the implementation of the program as defined by the year index. Estimated effects represent the net effect of the program in each year following the implementation of the program (not calendar years). The net effect excludes the effect of factors other than the SRTS program by allowing such factors to be represented in the control areas. The results are presented below for each of the road user groups/sub-groups examined.

### 5.2.1. All road users

The effect of the SRTS program in each year after implementation on the frequency of casualty crashes involving all road users is unclear. The results of the analyses are summarised in Table 7.

**Table 7. Estimated net average effect of the SRTS program on casualty crash frequency for all road users**

Year Index	All Times		School Travel Times Only	
	% change in casualty crashes	Pr > ChiSq	% change in casualty crashes	Pr > ChiSq
1	-8.0	<.0001	1.4	0.68
2	2.2	0.23	-0.7	0.86
3	0.1	0.98	-6.1	0.09
4	1.8	0.33	-5.8	0.11
5	2.9	0.13	-2.3	0.55
6	-7.5	0.00	-13.1	0.00
7	-4.1	0.05	-8.5	0.04
8	-4.6	0.03	-16.7	<.0001
9	5.7	0.02	-10.4	0.02
10	29.0	<.0001	8.2	0.19
11	27.4	<.0001	11.42	0.07

It is evident from these results that some of the estimated changes in casualty crash frequency are significant at the five percent level whilst others are not. The estimated changes in casualty crash frequency also vary widely from year to year. The lack of statistical significance of many of the results is most likely due to data insufficiency. Alternatively, the SRTS program may not have had an effect on all road users in all years. It is noted that both statistically significant increases and decreases in casualty crash frequency have been identified when considering crashes occurring at all times and at school travel times only. When testing at the five percent level, the average net effect of the program was to reduce

casualty crash frequency by approximately 4.8 percent for all road users at school travel times (see section 5.1). This is consistent with the above results, as it represents the average effect of the program over the post-implementation period. It is therefore possible for casualty crashes to increase in a particular year although the average effect of the SRTS program is to reduce casualty crash frequency amongst all road users at school travel times.

### 5.2.2. Primary school-aged children

No statistically significant changes in year-by-year casualty crash frequency were identified when fitting the model to crash data for primary school-aged children either at all times of day or at school travel times only. The results are summarised in Table 8.

**Table 8. Estimated net average effect of the SRTS program on casualty crash frequency for primary school-aged children**

Year Index	All Times		School travel times Only	
	% change in casualty crashes	Pr > ChiSq	% change in casualty crashes	Pr > ChiSq
1	4.2	0.62	-6.6	0.59
2	2.0	0.82	-1.0	0.94
3	-5.0	0.57	-12.2	0.34
4	-1.9	0.83	-15.2	0.24
5	-0.8	0.93	-7.3	0.61
6	0.2	0.99	-23.3	0.10
7	-13.7	0.17	-10.3	0.52
8	-1.8	0.87	-22.4	0.15
9	5.6	0.65	-19.7	0.24
10	21.3	0.17	-13.9	0.47
11	21.1	0.22	-24.5	0.24

Although not statistically significant, a large proportion of the estimated changes indicate that the SRTS program led to reductions rather than increases in casualty crashes. The aggregate analysis found no change in casualty crash frequency for this age group when considering crashes at all times of day. As with the year-by-year analysis this result was not statistically significant (see section 5.1). However, during school travel times casualty crash frequency was estimated to fall by 12.7 percent on average as a result of the SRTS program. This suggests that the results of the year-by-year analysis for primary school-aged children at school travel times is indicative of the overall effect although the magnitude of the reductions cannot be reliably estimated for each year due to data insufficiency.

### 5.2.3. Primary school-aged pedestrians and bicyclists

The most substantial reductions in casualty crash frequency identified in the aggregate analysis were for collisions involving primary school-aged pedestrians and bicyclists at all times and at school travel times only (17.9%). However, the majority of the estimated changes in casualty crash frequency from the year-by-year analysis are not statistically significant. Nevertheless, all estimated changes suggest that the SRTS program was associated with a decrease in casualty crashes (Table 9).

**Table 9. Estimated net average effect of the SRTS program on casualty crash frequency for primary school-aged pedestrians and bicyclists**

Year Index	All Times		School travel times Only	
	% change in casualty crashes	Pr > ChiSq	% change in casualty crashes	Pr > ChiSq
1	-2.3	0.83	-10.7	0.48
2	-16.6	0.12	-9.0	0.58
3	-21.3	0.04	-27.3	0.05
4	-13.8	0.23	-21.8	0.16
5	-7.7	0.52	-8.0	0.65
6	-2.8	0.84	-13.2	0.49
7	-24.2	0.06	-23.7	0.20
8	-7.4	0.61	-19.4	0.33
9	-18.7	0.22	-26.1	0.22
10	-1.5	0.94	-15.4	0.53
11	-27.8	0.14	-37.5	0.13

Given the encouraging results of the aggregate analysis in relation to this road user group it is expected that the above results are indicative of the direction of the change in casualty crashes associated with the SRTS program. The lack of statistical significance is likely due to insufficient data and the consequent reduced statistical power of the tests. Therefore, whilst the above results suggest that the SRTS program is associated with reductions in casualty crashes involving primary school-aged pedestrians and bicyclists, the exact magnitude of the effect in each year following the implementation of the program cannot be reliably estimated.

#### **5.2.4. Program Density Effects**

As discussed above, the lack of statistical significance of many of the results of the year-by-year analysis is most likely due to data insufficiency rather than a lack of genuine program effect. Therefore, the above results should be viewed as indicative of the likely effect only. It is expected that the magnitude of any crash effects associated with the SRTS program will be linked to the density of operation of the program. Based on the hypothesised density of operation (Table 4), constructed on the assumption of a three-year program effect, the greatest impact of the program would be expected to occur in years one to three as these years had the highest density of operation. However, the results of the year-by-year analysis suggest that the program was associated with the greatest crash reductions in years six to nine. Possible reasons for the apparent incompatibility of the hypothesised density of operation and the results of the analysis are discussed in section 6.0.

### **5.3. CRASH SEVERITY**

In addition to reductions in casualty crash frequency, the SRTS program may also lead to reductions in the severity of collisions in which particular road users are involved. Due to the lack of statistical significance of many of the results in the year-by-year analysis, the analysis of the effect of the program on crash severity was conducted using the aggregated post implementation data. A model of the form described in section 4.1 was fitted to casualty crash data for serious and fatal crashes only. The estimated effects generated by this analysis measure the average net effect of the SRTS program on the frequency of fatal and serious injury crashes only.

The analysis was conducted only for the road user groups in which statistically significant casualty crash reductions were found at the 5 percent level. The results are present in Table 10.

**Table 10. Estimated changes in the frequency of fatal and serious casualty crashes**

<b>Treatment group</b>	<b>Estimated % reduction in fatal and serious crashes</b>	<b>Estimated % reduction in all casualty crashes</b>	<b>Pr &gt; Chi sq</b>
All road users at school travel times only	-3.1	-4.8	0.65
Primary school-aged pedestrians and bicyclists at all times	- 13.1	-12.6	0.10
Primary school-aged road users at school travel times only	1.91	-12.7	0.92
Primary school-aged pedestrians and bicyclists at school travel times only	1.56	-17.9	0.95

The estimated reductions in the frequency of fatal and serious crashes were not statistically significant at the five-percent level. However, in the case of primary school-aged pedestrians and bicyclists, the estimated reduction was significant at the less stringent 10% level of significance. This indicates a reduction of 13% in fatal and serious injury pedestrian and bicyclist crashes, with 90% confidence. The lack of statistical significance of the remaining results may be due to insufficient data and the consequent low power of the statistical tests. Alternatively, the SRTS program may not have led to reductions in the severity of casualty crashes.

## 6.0 DISCUSSION

Overall, the evaluation of the Safe Routes to Schools program has shown that the program is associated with significant reductions in the frequency of collisions involving particular road user groups travelling at specific times. These results are consistent with expectations based on the nature of the program. The program was expected to have its greatest influence on the road users targeted by the program, that is, school-aged pedestrians and bicyclists. Further the effects were expected to be greatest during the times at which these road users travelled to and from school.

The effect of the SRTS program on casualty crash frequency could not be reliably estimated *for each year* following the introduction of the program, as many of the results obtained were not statistically significant. However, given the results of the aggregate analysis, it is believed that the lack of statistical significance was due to insufficient data at such a disaggregate level and the consequent reduced power of the statistical tests. Therefore, the estimated changes in casualty crash frequency will be indicative of the impact of the program although the exact magnitudes of any changes cannot be estimated.

The use of the year index in both sets of analyses enabled the effect of the SRTS program to be evaluated across all geographic clusters despite the staggered introduction of the program. The construction of the year index involved the allocation of an index to crashes occurring in each year in each cluster that reflected the time at which the program commenced in that cluster. In doing so, the results of the analysis relate to the effect of the program for each year following the implementation of the program (in the case of the year-by-year analysis) or the average net effect over the post-implementation period (in the case of the aggregate analysis). Despite the benefits of this approach, the variation in the profile of program density between clusters over time is still problematic. In particular, the estimated effects of the SRTS program on casualty crash frequency in the year-by-year analysis do not correspond with the hypothesised density of operation. The greatest effect of the program is not experienced in the years in which the largest number of schools are operating the program. The lack of consistency between the hypothesised density of operation and the results of the year-by-year analysis, indicates a potential difficulty with this approach.

The use of the year index facilitated the construction of a hypothesised density of operation. However, the results of the year-by-year analysis are not consistent with expectations based on this density. It would be expected that the greatest effect of the SRTS program would occur in the years in which the density of operation was greatest. The results of the year-by-year analysis, although not statistically significant in many cases, indicate that the program led to the greatest casualty crash reductions in years six to nine for most road user groups. These years do not correspond directly to the years in which the largest number of schools were involved in the program. Therefore, there does not appear to be a direct link between the density of operation as defined in this study and the expected magnitude of effect. However, in constructing the density of operation, it was assumed that the SRTS program would operate uniformly over a three-year period after which the program would have no effect. The results of the evaluation suggest that this assumption may have been unrealistic. Perhaps it is more realistic to expect the program effect to decline over time according to some function. Further, variation in program effect corresponding to the different stages of implementation

(education, engineering, encouragement and enforcement) should also be considered in future evaluations.

As stated above a number of estimated effects generated by the aggregate analysis were statistically significant. It is noted that the significant reductions in casualty crash frequency measure the net average effect of the program over the post-implementation period after adjusting for control.

Testing at the five-percent level of significance the operation of the SRTS program was associated with a 12.7 percent reduction in casualty crashes involving primary school-aged children at school travel times. However, this effect did not extend to primary school-aged children travelling at all times of day. Similarly, the SRTS program was shown to reduce casualty crash frequency amongst all road users at school travel times by 4.8 percent when testing at the five-percent level. However, this effect did not extend, in a statistically reliable form, to all road users travelling at all times of day. In contrast, reductions in casualty crash frequency were identified for primary school-aged pedestrians and bicyclists travelling at all times of day and during school travel times only. These results demonstrate that program effects are highly targeted.

These results also suggest that the program has effectively influenced the frequency of crashes involving primary school-aged pedestrians and bicyclists at all times, including school travel times. The focus of the SRTS program was on ensuring that primary school-aged children travelled along the safest routes and in a safe manner on the journey to and from school. However, the results of the evaluation suggest that the effect may have extended beyond these journeys to journeys taken by children as pedestrians and bicyclists at other times of the day. Further, the reductions in casualty crash frequency involving this road user group were the largest in magnitude. The SRTS program was associated with reductions in casualty crash frequency of 12.6 and 17.9 percent for primary school-aged pedestrians and bicyclists travelling at all times and at school travel times only respectively.

However, the cause of these casualty crash reductions is unknown. It is possible that the reduction in casualty crash frequency may be due to reduced exposure to these activities. Such a change in exposure may be due to parents and carers of children involved in the program now choosing to drive their children to school to reduce the risk of injury. Whether or not changes in exposure occurred and the causes of any such changes is unknown and beyond the scope of this study. Nevertheless, these issues should be considered when interpreting the results.

The 'spill over' effect was not found where all school-aged children were examined. The effect of the SRTS program on primary school-aged children when considered as a whole was significant only during school travel times where casualty crash frequency fell by an average of 12.7 percent. Similarly, the analysis found that when testing at the ten-percent level, there was a significant 4.8 percent reduction in casualty crash frequency for all road users at school travel times. No change in casualty crash frequency was established for all road users at all times. This suggests that the effect of the program extended beyond the main target group (primary school-aged pedestrians and bicyclists) to other road users but was restricted to road users travelling during school travel times only. The extended effect of the program may reflect the attention of the program to the involvement of parents and carers of children in the

education, encouragement and enforcement components of the program. However, the restriction of the reductions in casualty crash frequency to school travel times only, indicates that this wider effect may, for example, be linked to other road users accompanying children to and from school. Further research would be required to determine whether this is actually the case.

The reductions in casualty crash frequency were found to translate into crash savings of 22, 5, 6 and 4 crashes per year for all road users at school travel times, primary school-aged road users at school travel times, primary school-aged pedestrians and bicyclists at all times and at school travel times respectively. It is noted that the estimated reductions for sub-road user groups will contribute to the estimated reductions of the higher-level road user groups. The value of these crash reductions can be estimated using the relevant crash costs. However, no reliable estimates of the costs associated with the implementation of the SRTS program are available at this time to enable a full cost-benefit analysis. Nevertheless, these crash reductions confirm the existence of a 'spill over' effect with respect to both time and road user group. The crash savings associated with all road users at school travel times are greater than crash savings identified in sub-road user groups. Therefore, it cannot be said that a large effect in the smaller road user groups translates exactly into smaller effects in the larger road user groups. Consequently it is concluded that the effects estimated for the larger road user groups are genuine reductions for that road user group which extend beyond the reductions estimated for the smaller road user groups.

In addition to the reductions in casualty crash frequency the results of the analysis indicate that the SRTS program was associated with reductions in the frequency of fatal and serious injury crashes involving the targeted road users groups. In particular estimated reductions were found for primary school-aged pedestrians and bicyclists travelling at all times and at school travel times only. Further, estimated reductions were identified for all primary school-aged road users at school travel times only. Nevertheless, none of the estimated reductions was statistically significant. As discussed in section 5.3, this lack of statistical significance is most likely due to insufficient data. Therefore, these particular results should be treated with caution and at most be seen as indicative of the effect of the SRTS program.

Whilst the results presented above suggest that the SRTS program led to reductions in casualty crash frequency, the limitations of the evaluation must be discussed. In particular, the results of the statistical analysis demonstrate only an association between the SRTS program and the casualty crash reductions. No conclusions can be drawn from this evaluation concerning causation of these effects. In order to prove that the SRTS program caused the casualty crash reductions, behavioural change and observational studies would be required to support the results of the analysis conducted here. Such studies may also help to identify the mechanisms through which the SRTS program operated.

## 7.0 CONCLUSION

The evaluation of the effectiveness of the SRTS program demonstrates that the program has successfully reduced road trauma amongst a number of road user groups. The program was most successful in reducing the frequency of casualty crashes involving the primary targets of the program, primary school-aged pedestrians and bicyclists. The involvement of all primary school aged children in crashes at school travel times was also estimated to have fallen. Further, across all road user groups, the program was found to be associated with reductions in casualty crash frequency at school travel times when testing at the five-percent level of significance. The cost-effectiveness of the program was not fully evaluated given a lack of reliable data. However, the estimated SRTS program crash effects were translated into estimates of actual crashes saved.

The results of the year-by-year analysis were insufficient to draw firm conclusions about the magnitude of the program effects for each year following the introduction of the SRTS program. However, the results were generally consistent with the aggregate analysis. Similarly, given the available data, reductions in the severity of casualty crashes across road user groups could not be identified.

A number of recommendations for further research into the mechanisms underlying the effectiveness of the SRTS program have been identified.

- An analysis of the contribution of each of the four components of the SRTS program (education, engineering, encouragement and enforcement) to the estimated crash savings would assist in optimising the benefits of any future program. This would enable investment to be targeted at the components of the program that produce the greatest benefit relative to cost.
- The effect of the SRTS program on casualty crash frequency was assumed to be uniform throughout the operation of the program in schools. An examination of the variation in program effect corresponding to the different stages of implementation of the program (i.e. education, engineering, encouragement and enforcement) would broaden the understanding of the mechanisms behind the program effect. However, a lack of data at this disaggregate level may prevent such analysis.
- Changes in exposure amongst the road user groups examined may have contributed to the decrease in casualty crash frequency within these groups. Future analysis of exposure data could help to determine whether this is in fact the case or whether the casualty crash reductions were genuine.
- Presently, the results of the analysis demonstrate an association between the SRTS program and casualty crash reductions amongst a number of road user groups. Behavioural studies are required to provide a causative link between the program and its effect.

## 8.0 LIMITATIONS AND ASSUMPTIONS

In producing the estimates of program effectiveness presented in this study, a number of assumptions have been made and a number of limitations of the results need to be noted. The following limitations and assumptions are identified.

- The information concerning the schools involved in the SRTS program, the start dates of the program in those schools and the information relating to the likely effect of the program provided by VicRoads was accurate.
- Extraction of crash data sites carried out by VicRoads was accurate.
- The choice of study design was appropriate and that the control areas used in the study adequately reflected the influence of factors other than the treatment at treated sites over the study period.
- Statistical analysis presented in this report cannot prove unequivocally that the SRTS program led to the attributed crash reductions. It is possible that other unrelated but concurrent events led to the effects observed, although this is considered unlikely given the analysis design employed. Further, it cannot be determined whether the estimated reductions in casualty crashes occurred on the treated routes.
- The results of the analysis relate to the implementation of the SRTS program as it occurred from 1990 to 2000. Changes in the components of the program, the method of implementation or the number and type of schools running the program would alter the expected effect of the program.

## 9.0 REFERENCES

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**APPENDIX A**

**SCHOOLS INVOLVED IN THE SRTS PROGRAM**



**Table 1: Details of Schools Involved in the SRTS Program**

Year of Commencement	School Name	Cluster			
1995	Yarragon	1	1998	Killester College	8
1996	Grey Street	1	1998	Westall Primary College	8
1996	St Gabriels	1	1998	Frankston Primary School	9
1996	Stockdale Road	1	2000	Aldercourt Primary School	9
1996	Auburn Primary School	7	2000	Kananook Primary School	9
1996	Carey Baptist Grammar	7	2000	Monterey Primary School	9
1996	Genazzano Girls School	7	2000	Pine Forest Primary	9
1996	Glenferrie Primary School	7	2000	Rosebud Primary School	9
1996	Methodist Ladies College	7	1992	Boronia	10
1996	Preshill Prep.	7	1992	Boronia Heights	10
1996	Ryton Girls Grammar	7	1992	Boronia West	10
1996	Sacred Heart Primary School	7	1992	Fairhills	10
1996	St Joseph's Primary School	7	1992	Ferntree Gully North	10
1998	Trinity Grammar Junior	7	1992	St Bernadettes	10
1998	Xavier College Junior School	7	1992	The Basin	10
1990	Chandler Primary	8	1992	Wattle View	10
1990	Coomoora Primary	8	1992	Elwood	11
1990	Heatherhill Primary	8	1992	Mt Scopus	11
1990	Keysborough Park Primary	8	1992	St Colemans	11
1990	Noble Park Primary	8	1992	St Columbas	11
1990	Resurrection Primary	8	1992	St Kilda	11
1990	Southvale Primary	8	1992	St Kilda Park	11
1990	Springvale South Primary	8	1992	St Marys	11
1990	St. Anthony's	8	1993	Sacred Heart	11
1990	Wallarano	8	1993	Sandringham	11
1991	Dandenong North	8	1994	Brighton Beach Primary	11
1991	Dandenong West	8	1994	Brighton Grammar Junior	11
1991	Greenslopes Primary	8	1994	Elsternwick Primary School	11
1991	Lyndale Primary	8	1994	Firbank Junior School	11
1991	Oakwood Primary	8	1994	Gardenvale Primary School	11
1991	Wooranna Park Primary	8	1994	St. Leonards Junior School	11
1997	Dandenong	8	1994	St.James Catholic Primary	11
1997	Dandenong North	8	1994	St.Joan of Arc Catholic Primary	11
1997	Dandenong South	8	1994	Xavier (Kostka Hall)	11
1997	Dandenong West	8	1997	Bentleigh West Primary School	11
1997	Greenslopes Primary	8	1997	St Paul's Catholic School	11
1997	Harrisfield	8	1998	Our Lady's Primary School	11
1997	Heatherhill Primary	8	2001	Adass Israel School Junior	11
1997	Lyndale Primary	8	2001	Caulfield Grammar Senior	11
1997	Springvale	8	2001	Cheltenham East Primary	11
1997	Springvale Heights	8	2001	Cheltenham Primary	11
1997	Springvale West	8			
1997	St Gerards	8			
1997	St Josephs	8			
1997	St Mary's	8			

2001	Kingston Heath Primary	11	2001	St Thomas the Apostle Primary School	13
2001	Le Page Primary	11	1996	Croydon West	15
2001	Melbourne Grammar	11	1996	Holy Spirit	15
2001	Mentone Boys Grammar	11	1996	Kalinda	15
2001	Mentone Park Primary School	11	1996	Mullum	15
2001	Mentone Primary School	11	1996	Norwood Secondary	15
2001	Mount Scopus College	11	1996	Parkwood Secondary	15
2001	Our Lady of the Assumption	11	1996	Ringwood Heights	15
2001	Parktone Primary	11	1996	Ringwood North	15
2001	Ripponlea Primary School	11	1996	Warrenwood	15
2001	Shelford Anglican Girls	11	1996	Yarra Valley Junior	15
2001	Sholem Aleicham College	11	1998	Aquinas College	15
2001	St Patrick's Catholic Primary	11	1998	Great Ryrie Primary School	15
2001	St. Bedes College	11	1990	Coburg Islamic Primary	16
2001	St. Josephs School	11	1990	Coburg North Primary	16
1993	Bilanook	12	1990	Coburg Primary	16
1993	Gladesville	12	1990	Moreland Primary	16
1993	Kilsyth	12	1990	St Bernards Primary	16
1993	Montrose	12	1990	St Pauls Primary	16
1993	Mooroolbark	12	1991	Brunswick East Primary	16
1993	Mooroolbark East	12	1991	Brunswick Primary	16
1993	Pembroke	12	1991	Brunswick South West Primary	16
1993	St Richards	12	1991	Our Lady Help of Christians Primary	16
1995	Box Hill North	13	1991	St Ambrose Primary	16
1995	Kerrimuir	13	1991	St Margaret Marys	16
1995	Kingswood Junior College	13	1992	Braybrook	16
1995	Laburnum	13	1992	Christ the King	16
1995	Our Lady of Scion	13	1992	Glengala	16
1995	Roberts McCubbin	13	1992	Glengala Park	16
1995	St Clares	13	1992	Maidstone	16
1995	St Francis	13	1992	Our Lady's	16
1998	St.Francis XavierPrimary School	13	1992	St Marys	16
2000	Balwyn Primary School	13	1992	St Peters	16
2000	Camberwell Grammar Junior School	13	1992	Sunshine	16
2000	Fintona Girls' School Junior School	13	1992	Sunshine East	16
2000	Mont Albert Primary School	13	1992	Sunshine Heights	16
2000	Surrey Hills Primary School	13	1992	Sunvale	16
2001	Blackburn Primary School	13	1992	Tottenham North	16
2001	Doncaster Primary School	13	1992	Williamstown	16
2001	Mount Scopus College	13	1993	Richmond	16
2001	Old Orchard Primary School	13	1993	Richmond Community	16
2001	St Peter & St Paul Primary School	13	1993	St Ignatius	16
			1993	St James	16
			1993	St Johns	16
			1994	Graham Street	16
			1995	Fairfield	16
			1995	Newlands	16
			1995	Northcote	16
			1995	Preston West	16
			1995	Reservior	16
			1995	Reservior West	16

1995	Ruthven	16	1996	St Dominics	22
1995	St Anthonys	16	1996	Castlemaine North	25
1995	St Gabriels	16	1996	Kennington	25
1995	St Joseph the Worker	16	1997	Camp Hill	25
1995	St Josephs	16	1997	Creek Street	25
1995	Westgarth	16	1997	St Joseph's	25
1996	Brunswick	16	1997	St Killians	25
1996	Brunswick East Primary	16	1999	Ballarat & Clarendon	25
1996	Coburg	16	1999	Dana St, Ballarat	25
1996	Coburg Islamic Primary	16	1999	St Aloysius' PS Ballarat	25
1996	Coburg North Primary	16	1999	St Patrick's PS, Ballarat	25
1996	Moreland Primary	16	1999	Urquhart Park, Ballarat	25
1996	Our Lady Help of Christians Primary	16	2000	Bendigo	25
1996	St Ambrose Primary	16	2000	Bendigo North	25
1996	St Bernards Primary	16	2000	California Gully Bendigo	25
1996	St Margaret Marys	16	2000	Comet Hill	25
1996	St Pauls	16	2000	Eaglehawk	25
1998	Holy Name Primary School	16	2000	Eaglehawk North	25
1994	Bethal	18	2000	Flora Hill Bendigo	25
1994	Broadmeadows West	18	2000	Kangaroo Flat	25
1994	Meadow Heights	18	2000	Maple St Golden Square	25
1994	Meadowfair North	18	2000	Mildura PS	25
1994	Westmeadows	18	2000	Mt Pleasant PS, Ballarat	25
1994	Westmeadows Heights	18	2000	Quarry Hill Bendigo	25
1994	Kings Park	19	2000	Redan PS., Ballarat	25
1994	Movelle	19	2000	Sebastopol PS.	25
1994	Resurrection	19	2000	St Liborius	25
1994	Sacred Heart	19	2000	St Monica's	25
1994	St Albans	19	2000	St Therese's	25
1994	St Albans East	19	1990	St Bernard's B/Marsh	26
1994	St Albans North	19	1992	Corio	26
1994	St Pauls Kealba	19	1992	Corio West	26
1994	Stevensville	19	1994	Ashby	26
1993	Doveton Heights Primary	20	1994	Corio	26
1993	Doveton North Primary	20	1994	Corio Community College	26
1993	Eumemmerring Primary	20	1994	Corio West	26
1993	Hallam Primary School	20	1994	Francis Xavier	26
1993	Holy Family Catholic Primary	20	1994	Herne Hill	26
1993	James Cook Primary	20	1994	Manifold Heights	26
1996	Findon	21	1994	Norlane West	26
1996	Lalor	21	1994	Our Lady's	26
1996	Lalor East	21	1994	Rosewall	26
1996	Lalor North	21	1994	St Anthonys	26
1996	Mill Park	21	1994	St Patricks	26
1996	St Johns	21	2000	Bacchus Marsh PS	26
1996	St Lukes	21	1995	Bourchier St PS	27
1996	Thomastown East	21	1995	Goulbourn SDS	27
1996	Coburn	22	1995	Gowrie St PS	27
1996	Melton	22	1995	Graham St SDS	27
1996	Melton South	22	1995	St Brendans-Catholic	27
1996	Melton West	22	1999	Guthrie St PS	27
1996	St Anthonys	22	1999	Mooroopna Park PS	27
			1999	St Georges Rd PS	27
			1999	StMels PS	27

1999	Wilmot Rd PS	27
1996	Appin Park PS	28
1996	Our Ladys - Catholic	28
1996	Rochester	28
1996	St Bernards - Catholic	28
1996	Wangaratta SDS	28
1996	Wangaratta West PS	28
1996	Yarrunga PS	28

## **APPENDIX B**

### **POSTCODE AND LGAs IN EACH CLUSTER**



**Table 1. Treatment Postcodes and LGAs**

<b>Geographic Cluster</b>	<b>Year Commenced</b>	<b>Year of Operation Index</b>	<b>No. of Schools Introduced in Commencing Year</b>	<b>Treatment Postcodes</b>	<b>LGA</b>
1	1995	1	1	3823, 3844	1B, LE, WU
1	1996	2	3		
7	1996	1	10	3101, 3122, 3123, 3124	B3
7	1998	3	2		
7	2000	5	1		
8	1990	1	10	3169, 3170, 3171, 3172, 3173, 3174, 3175	HM, M8
8	1991	2	6		
8	1997	8	14		
8	1998	9	3		
9	1998	1	1	3198, 3199, 3200, 3939	M7, NJ
9	2000	3	5		
10	1992	1	8	3154, 3155, 3156, 3180, 3785	KI
11	1992	1	7	3004, 3141, 3161, 3162, 3181, 3182, 3183, 3184, 3185, 3186, 3187, 3188, 3189, 3190, 3191, 3192, 3194, 3195, 3202, 3204,	B9, GK, KO, MH, PI, ST
11	1993	2	2		
11	1994	3	9		
11	1997	6	2		
11	1998	7	1		
11	2001	NA	20		
12	1993	1	8	3137, 3138, 3765	YF
13	1995	1	8	3103, 3108, 3109, 3125, 3126, 3127, 3128, 3129, 3130	M6, WV
13	1996	2	2		
13	1998	4	1		
13	2000	6	5		
13	2001	NA	7		
15	1996	1	11	3111, 3114, 3134, 3135, 3136	M9
15	1998	3	2		
16	1990	1	6	3016, 3019, 3020, 3030, 3032, 3039, 3044, 3055, 3056, 3057, 3058, 3068, 3070, 3071, 3072, 3073, 3078, 3121, 3207	DJ, HK, MW, MY, MZ, WT, YE
16	1991	2	6		
16	1992	3	14		
16	1993	4	5		
16	1994	5	1		
16	1995	6	12		
16	1996	7	11		
16	1998	9	1		
18	1994	1	6	3047, 3048, 3049	HL
19	1994	1	9	3021, 3023	B7
20	1993	1	6	3177, 3802, 3803	CU
20	1998	6	1		
21	1996	1	8	3074, 3075, 3076, 3082, 3083	B6, NI, WW
22	1996	1	6	3337, 3338	MI
25	1996	1	2	3450, 3500, 3550, 3555, 3556	B4, B5, LF, VE, VF
25	1997	2	4		
25	1999	4	5		
25	2000	5	17		

26	1990	1	1	3214, 3215, 3218, 3340	GH, MX
26	1992	3	2		
26	1994	5	13		
26	2000	11	1		
27	1995	1	5	3629, 3630	GI
27	1999	5	5		
28	1996	1	7	3677	MI

