University of Southern Queensland

Faculty of Engineering and Surveying

The 50 kph Speed Limit in Residential Toowoomba

A dissertation submitted by

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In fulfilment of the requirements of

Courses ENG4111 and 4112 Research Project

towards the degree of

Bachelor of Engineering (Civil)

Submitted: October, 2009

Abstract

On the 1st of February 2003, the default urban speed limit was reduced from 60km/h to 50km/h for all local streets in Queensland. The 50km/h speed limit was introduced the number and severity of crashes that occur on local streets in Queensland, making them a safer environment for all users.

The primary aim of the 50km/h speed limit was to reduce the amount and severity of crashes that occur on local streets, focusing heavily on pedestrian crashes. Everyone that lived in Queensland in late 2002 and early 2003 may remember the television advertising campaign for the 50km/h safety initiative, with the child running onto the road and a car stopping before hitting the child while showing a transparent car travelling through the child. This campaign was used to illustrate the braking difference between travelling at 60km/h rather than 50km/h, and a possible consequence for drivers travelling at 60km/h on local residential streets where children play.

The aim of this dissertation was to evaluate the effectiveness of the 50km/h default urban speed limit in Toowoomba. This was done by analysing crash data for local streets in Toowoomba where the speed limit changed from 60km/h to 50km/h, looking at the severity level of all crashes, and crashes involving pedestrians for 5 years before and after the 50km/h speed limit was introduced. An economic analysis of the safety initiative was also performed, comparing the results against evaluations conducted in different states and territories of Australia that have also adopted a 50km/h default urban speed limit.

The results of this evaluation found that for Toowoomba there was an 8% decrease in the total amount of crashes that occurred on 50km/h streets, which is close to the 9% that was achieved for the ACT. A 17% decrease in all casualty

crashes in Toowoomba was similar to the 19% decrease achieved by NSW and the 13% for Victoria. A 28% decrease was achieved for all crashes involving pedestrians which was the 2nd highest decrease after 51% in WA. There were an insufficient number of fatal crashes in 50km/h zones to make a valid analysis.

The economic analysis found that over the 5 years after the 50km/h speed limit was introduced in Toowoomba, there was a saving of $2.99 million dollars, and a benefit-cost ratio of 7.6. The only other economic analysis that was conducted was for the ACT emulation, which had a benefit-cost ratio of 8.2.

The results of this evaluation support the implementation of the 50km/h default urban speed limit, by displaying a decrease in the amount and severity of crashes on Toowoomba's 50km/h streets, with a BCR of 7.6 and a 3km/h reduction in 85th percentile vehicle speed.

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ENG4111 Research Project Part 1 & ENG4112 Research Project Part 2

Limitations of Use

Professor Frank Bullen
Dean
Faculty of Engineering and Surveying

Certification

I certify that the ideas, designs and experimental work, results, analyses and conclusions set out in this dissertation are entirely my own effort, except where otherwise indicated and acknowledged.

I further certify that the work is original and has not been previously submitted for assessment in any other course or institution, except where specifically stated.

Philip Baker

Student Number: 0050026507

Signature

Date

Acknowledgements

I would like to thank my project supervisor Mr Trevor Drysdale, for his assistance and guidance throughout this research project.

I would also like to thank the following people for their assistance in supplying me with the requested data for use in this research project:

Chris Martin

Technical Officer – Engineering GIS

Toowoomba Regional Council

Greg Smith

Co-ordinator Traffic Signals and Road Lighting

Toowoomba Regional Council

The Data Analysis Division of the Department of Transport and Main Roads

I would also like to give special thanks to Rose & Christopher Baker and Franciska Eckard for their assistance and support with this research project over the last few weeks, and my friends and family who have supported and encouraged me throughout the year.

Philip Baker

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Central Business District (CBD)

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Driving Under the Influence of drugs or alcohol (DUI)

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Definitions

Urban sprawl – urban sprawl is where the population expands outwards keeping a similar population density rather than increasing in density and keeping the population close to the city centre.

Queensland Transport (QT) – Queensland Transport is the main government body responsible for investigating and implementing road safety campaigns in the state of Queensland.

Toowoomba Regional Council (TRC) – Toowoomba Regional Council is the local government authority responsible for Toowoomba City and surrounding towns, after the council amalgamations.

85th Percentile Speed – The speed at, or below , which 85 percent of vehicles are observed to travel under free flowing conditions past a nominated point. A vehicle is considered to be operating under free flowing conditions when the preceding vehicle has at least 4 seconds headway and there is no apparent attempt to overtake the vehicle ahead (Department of Main Roads 2003).

Chapter 1 Introduction

The basis of this research project is to investigate how effective the speed limit reduction from 60km/h to 50 km/h has been on local residential streets, since it was introduced on the 1st of February 2003. The 60km/h default urban speed limit for Australia originated in 1974, when Australia was converting from the imperial unit system to the metric unit system. Prior to 1974, Australia had a default urban speed limit of 35 miles per hour, which roughly converts to 56 km/h. The traffic engineers of 1974 felt constrained to choose between 60km/h and 50km/h, and it was decided to go with 60km/h. At a conservative estimate, about two thousand pedestrian's lives may have been saved since 1974 if the decision was instead made to adopt a 50km/h speed limit

The speed limit reduction was initially introduced to built-up areas of south-east Queensland in March 1999, and produced a statistically significant reduction in crash severity and total crashes. The amount of fatal crashes decreased by 88%, and the amount of crashes on residential streets decreased by 22% in south-east Queensland during the trial period (Hoareau et al. 2002). Due to the success of the speed limit reduction initiative it was introduced state wide in February 2003. An amnesty period of 3 months for unsigned streets was given, where drivers caught exceeding the 50 km/h speed limit were pulled over and warned, and drivers speeding excessively or driving dangerously were still prosecuted. The crash data analysis for this report will only be for the Toowoomba area, but will compare the effectiveness of the decreased speed limit in Toowoomba with other areas in the state and country.

The primary purpose of the speed limit reduction was to make local residential streets a safer place and a more pleasant place to live, as approximately one-third of all crashes resulting in injury occur on residential streets (Queensland Government 2003 [Brochure]). The lower speed limit allows motorists more time to react and stop in a shorter distance, as a vehicle travelling at 50km/h stops 14 metres shorter than one travelling at 60km/h. This allows the driver a better opportunity to avoid unexpected activities which happen on local streets, such as children running out onto the road or motor vehicles and bicycles suddenly driving out onto the road from driveways.

The effectiveness of the speed limit reduction in Toowoomba will be determined by analysing crash data collected from Queensland Transport from January 1998 till November 2007. The crash data will be used to compare the crash severity and total amount of crashes, from before the speed limit was introduced to those after the speed limit reduction was introduced.

1.1 Dissertation Overview

Chapter 2 consists of a literature review which provides a definition of a road crash and an overview of the different severity levels of crashes. This chapter also covers the road hierarchy for Toowoomba and what is defined as a local street as well as introduces the contributing factors that can result in a crash.

Chapter 3 provides information about other countries that have previously implemented the 50km/h urban speed limit. This chapter will also detail information about when and how the 50km/h speed limit was implemented to other Australian States and Territories of Australia and the crash results they have achieved.

Chapter 4 gives background information about the study area of Toowoomba City and information relating to the Toowoomba road network and its population.

Chapter 5 describes the data that was attained for the research project and the methodology used to extract and manipulate the data required for this research project.

Chapter 6 goes into detail regarding the results achieved by the crash data analysis, the findings of the cost analysis, the observations made during the site inspections of identified crash black spots on 50km/h streets and the results of the speed survey analysis. This chapter will also discuss and summarise the identified findings.

Chapter 7 concludes the findings of the evaluation for this dissertation and recommends other possible areas of study that could be investigated that became apparent as a result of this evaluation.

Chapter 2 Literature Review

2.1 Introduction

Before analysing the crash data, a literature review was undertaken to determine what defines a road crash, the different severity levels of road crashes and what is classified as a local residential street is. These three points will provide the basis for analysing the data obtained. This chapter will also focus on what factors contributes towards a road crash, the limitations of the crash data obtained for the project and how a crash types is defined through crash coding.

2.2 Road Crash

Austroads published a report "*A minimum common dataset for the reporting of crashes on Australian Roads*" in 1997. The purpose of the report was to implement a minimum dataset for all road authorities to work towards, so there will be a consistency of data obtained from all road authorities. The road crash data obtained was from 1998 to 2007 and is therefore assumed that the date received will comply with this particular standard. The data was obtained from Queensland Transport who was part of the working party responsible for the development of the minimum common dataset.

In “*A minimum common dataset for the reporting of crashes on Australian Roads*” a road crash is defined as:

> *A Road Crash is an apparently unpremeditated event which results in the death or injury to a person or property damage and is attributable to the movement of a road vehicle on a public road (including vehicles entering or leaving a public road). This definition specifically excludes:*
>
> - *Crashes on private property or on a public road that has been temporarily closed*
> - *A crash where no moving road vehicle is involved (for example, a pedestrian walks into a parked vehicle or another pedestrian) or*
> - *A crash involving deliberate intent (such as murder or suicide)*
>
> (Austroads 1997, p.2)

Further building on the definition of a road crash, all crash data acquired from Queensland Transport comes with a disclaimer stating that for a crash to be added to their database it must meet the following criteria:

- the crash occurs on a public road
  - A person is injured
  - Or the value of the property damage is:
    - (a) $2500 to property other than vehicles (after 1 December 1999)
    - (b) $2500 damage to vehicle and property (after 1 December 1991 and prior to 1 December 1999)
    - (c) value of property damage is greater than $1000 (prior to December 1991)
  - Or at least one vehicle was towed away

(Data Analysis Unit 2008)

The above mentioned definition and criteria of a road crash will be used as the basis for road crashes in this report. Road crashes can be further classified into five different severity levels.

2.3 Crash Severity

The Queensland Transport crash databases give five different levels of crash severity. A brief description of the 5 levels of crash severity is given in Table 2.1, with level one being the most severe and level 5 being the least severe.

Level	Crash Severity	Description
1	Fatal	At least one fatality
2	Hospitalisation	The most seriously injured person(s) in the crash requires hospitalisation (as inpatient)
3	Medical Attention	The most seriously injured person(s) in the crash requires medical attention - As a hospital (as outpatient) - At a general practitioner
4	Minor Injury	The most seriously injured person(s) in the crash did not require medicinal attention - Onsite first aid - Not injured
5	Property Damage	Reported crashes where no one was injured but a car was towed away or property damage exceeded $2500

Table 2.1 Crash Severity Levels

Source: Hoareau et al. 2002

A fatal crash can be further defined according to Austroads (1997, p2) as:

A fatal crash is one where a person is killed outright or dies within 30 days of a crash from injuries attributed to the crash, excluding:

- *A person who dies within 30 days of the crash where factors other than injuries sustained in the crash are deemed to have been a primary cause of death (for example, driver of a road vehicle who dies from a condition such as cerebral haemorrhage, heart attack or diabetic coma);*
- *A person not directly involved in a road vehicle crash who dies as a result of witnessing a crash;*
- *A person killed where deliberate intent in clearly established (for example, driver who suicides, person killed as a result of homicidal intent); and*
- *A person killed or injured where vehicle movement is not deemed to be the primary factor contributing to the death or injury.*

In compliance with world health organisation guidelines, details of foetal death should be recorded where the foetus weighed in excess of 500 grams or, where weight is unavailable was of at least 22 weeks' gestation.

There are four main groups of crashes:

- Fatal Crashes – crashes from crash severity 1;
- Casualty Crashes – combined crashes from severity level 1,2, 3 and 4;
- Property Damage Crashes – crashes from severity level 5;
- Total Crashes – crashes from severity levels 1, 2, 3, 4 and 5

The severity of the crashes that occurred after the speed reduction was introduced will be analysed against crash data before it was introduced to identify if the severity of crashes decreased on local residential streets.

2.4 Road Hierarchy

The road hierarchy is a tool used to assist in the development of an efficient and effective road network system in conjunction with land use in the urban environment. A classification system is used for defining the main purpose and objectives of a roadway, so the appropriate design criteria can be used. The objectives and design criteria are aimed at achieving an efficient road system whereby conflicts between the roadway and adjacent land use are minimised and the appropriate level of interaction between the roadway and land use is permitted (Eppell, Bunker & McClurg, 2001).

Roadways serve a variety of functions include providing direct access to properties, access for through traffic not related to nearby land use, pedestrian and bicycle paths and bus routes. Most roads serve more than one function, though when incompatible road uses are mixed on a single roadway, the chance of an undesirable incident occurring is increased. To minimize the likelihood of undesirable incidents occurring, Eppell Olsen & Partners developed a four level road hierarchy, so that the appropriate level of interaction between the roadway and land use can be planned. The four level road hierarchy has been adopted by a number of planning agencies in Queensland.

The Four Levels of the road hierarchy are:

Level 1. **Purpose,** *relates to the primary objective of the element, whether to carry through traffic or provide direct property access.*

Level 2. ***Function****, relates to the relationship between the roadway and the land use it serves (i.e. how the roadway serves the land use).*

Level 3. ***Management****, relates to the emplacement of policies to achieve the envisaged function based upon the attributes of the element and of the adjacent land uses.*

Level 4. ***Design****, relates to specification of the form of the element in order to achieve its functional objectives.*

(Eppell, Bunker & McClurg, 2001, p5)

For the purpose of this report only level 2 of the road hierarchy will be discussed as it primarily deals with the different functions and classifications of a roadway. Table 2.2 illustrates the four levels of road hierarchy with the road classifications given in level 2 and figure 2.1 is a map of the road hierarchy for Toowoomba, from the Toowoomba Regional Council Planning scheme.

Road Hierarchy Levels and Objectives *Table 1*

<table>
<tr><th colspan="10">LEVEL 1: PURPOSE</th></tr>
<tr><th colspan="6">ROAD</th><th colspan="4">STREET</th></tr>
<tr><td colspan="6">• to carry through traffic</td><td colspan="4">• to provide local property access
• to collect local traffic</td></tr>
<tr><th colspan="10">LEVEL 2: FUNCTION</th></tr>
<tr><th colspan="3">ARTERIAL ROAD</th><th colspan="3">SUB ARTERIAL ROAD</th><th colspan="2">COLLECTOR STREET</th><th colspan="2">LOCAL STREET</th></tr>
<tr><td colspan="3">• through traffic movements
• longer distance traffic movements
• line haul public transport task
• primary freight and dangerous goods routes
• regional cycle movements (off road)</td><td colspan="3">• connections between local areas and arterial roads
• connections for through traffic between arterial roads
• access to public transport
• through movement of public transport
• regional – local cycle movements (off road)
• pedestrian movements</td><td colspan="2">• carry traffic having a trip end within the specific area
• direct access to properties
• access to public transport
• pedestrian movements
• local cycle movements</td><td colspan="2">• direct access to properties
• pedestrian movements
• local cycle movements</td></tr>
<tr><th colspan="10">LEVEL 3: MANAGEMENT</th></tr>
<tr><th>Highway</th><th>Arterial</th><th>Arterial Main Street</th><th>Traffic Distributor</th><th>Controlled Distributor</th><th>Sub Arterial Main Street</th><th>Major Collector</th><th>Minor Collector</th><th>Access Street</th><th>Access Place</th></tr>
<tr><td colspan="10">The aim of management policies for these categories will be to facilitate:</td></tr>
<tr><td>• longer distance traffic movements
• regionally and nationally significant movements</td><td>• longer distance traffic movements</td><td>• longer distance traffic movements
• access to commercial properties</td><td>• connection of local areas to arterial roads</td><td>• connection of local areas to arterial roads
• access to properties (certain existing cases). Treatment may control some aspects of traffic operation to ameliorate impacts</td><td>• connection of local areas to arterial roads
• access to commercial properties. Treatment may involve preservation of aspects of local amenity in balance with traffic operation</td><td>• connection of residential streets with traffic carrying roads
• access to grouped/ commercial properties and community facilities</td><td>• connection of residential streets with traffic carrying roads
• access to individual adjacent properties</td><td>• access to individual adjacent properties
• access to local area</td><td>• access to individual adjacent properties</td></tr>
<tr><th colspan="10">LEVEL 4: DESIGN</th></tr>
<tr><td colspan="10">• according to relevant guidelines and codes including Council subdivision guidelines, AUSTROADS Guides, Queensland Streets, AMCORD, Australian Standards</td></tr>
</table>

Table 2.2 Road Hierarchy Levels and Objectives

Source: (Eppell, Bunker & McClurg, 2001, p6)

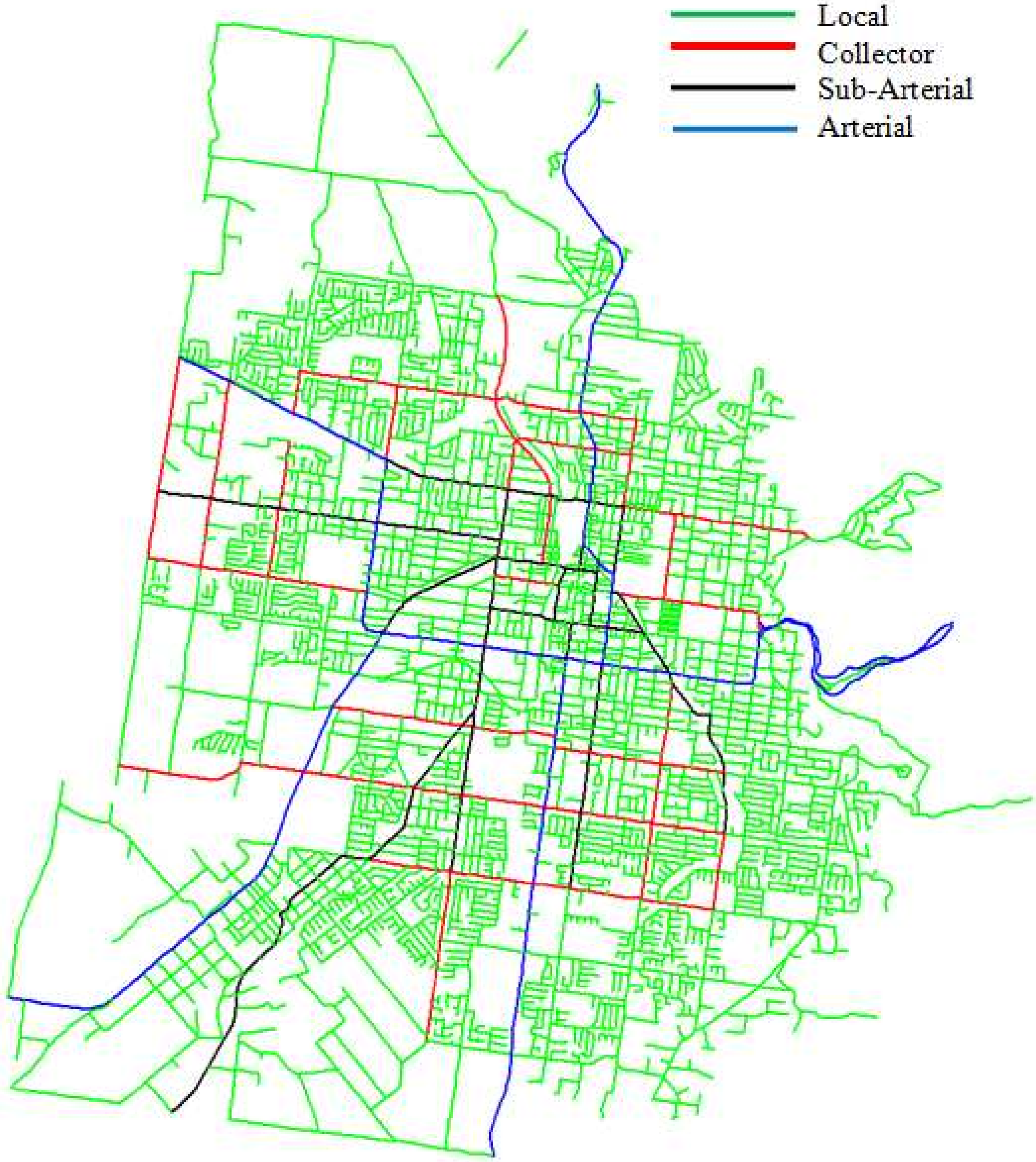

Figure 2.1 Toowoomba Road Hierarchy

The most common and widely known part of the four levels of Road Hierarchy is level 2, the four classifications of roads:

- **Arterial Roads** - to carry long distance through traffic external to specific areas;
- **Sub-arterial Roads** - to carry through traffic between specific areas and arterial roads on a supporting role to the latter;
- **Collector Streets –** to provide connectivity between the environmental cells and the traffic carrying road and serve property access; and
- **Local Streets –** to provide direct property access.

(Eppell, Bunker & McClurg, 2001, p7)

The primary roadway being looked at in this report will be the local streets or local residential streets as they are referred to by Queensland Transport, "A local residential street is one that is mainly used to provide direct access to homes and private property" (Queensland Transport 2003). Local streets are designed to predominantly carry neighbourhood traffic and very little through traffic, while collector streets are designed to carry mostly through traffic while providing access to adjacent properties. With the implementation of the default 50 km/h speed limit in Queensland, all local residential streets became 50 km/h with collector streets staying 60km/h and signed. A map showing the road network in Toowoomba can be seen in Figure 2.2 (Toowoomba Regional Council 2009), with the green lines representing streets with a 50km/h speed limit, the light blue lines being signed 50km/h streets and the dark blue lines being streets with a speed limit of 60 km/h.

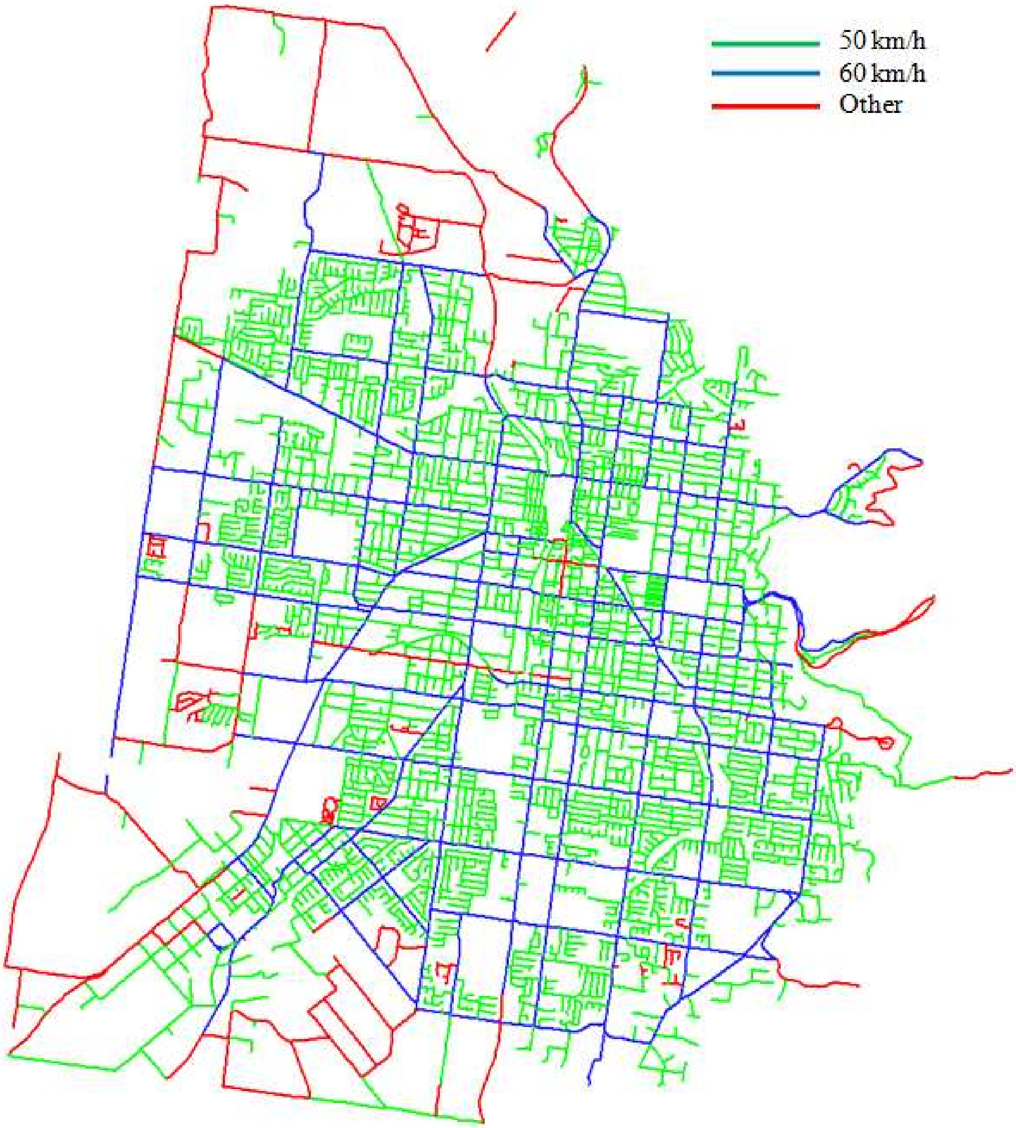

Figure 2.2 Map of Speed Limits of Toowoomba Streets

2.5 Main Crash Factors

There are three major contributing factors to road crashes:

- Road User
- Road Environment
- Vehicle

The interaction between these factors is very complex and overlap each other to an extent as seen in figure 2.3.

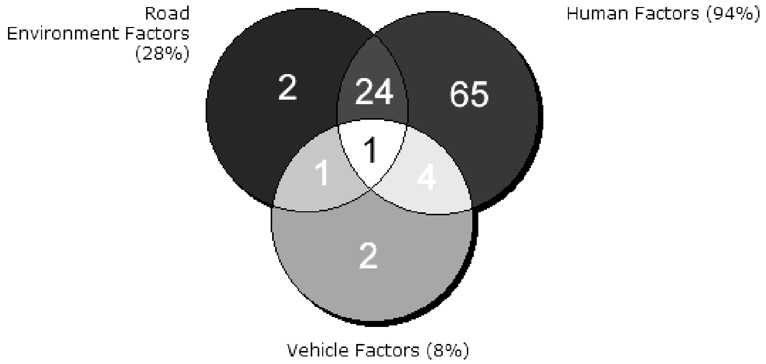

Figure 2.3 Crash Factors

Source: Main Roads Western Australia 2009

2.5.1 The Road User

The most basic task of road design is to design a safe road where the road user can make good decisions and interact effectively with the traffic system, whether it is a driver, pedestrian or cyclist. It is important that the road is designed with human performance, capabilities and behaviours in mind.

Driving consists of three essential tasks:

- **Navigation –** trip planning and route following
- **Guidance –** following the road and maintaining a safe path in response to traffic conditions
- **Control –** steering and speed control

(Austroads 2009)

To do these tasks effectively the driver must receive information which is most often visual. They must then process the information and act upon it. Some of the factors that affect the information processing stage are expectancy, reaction time, memory, experience, visual field, eye and head movements and illumination. Some factors that increase poor decision making are inexperience, high stress environments, unexpected events, intense driver attention features, insufficient or too much information and a lack of motivation.

Other significant contributing factors to road crashes and fatalities are the behavioural factors “Fatal 4”; speeding, driving under the influence, fatigue and inattention. Speeding affects a driver’s ability to avoid crashes by not only requiring a longer distance to decrease speed, but there is also the greater distance travelled during the average 1.5 seconds for a driver to react to an unexpected event. This can be seen in figure 2.4. Driving under the influence of alcohol and illegal drugs dramatically increases the chance of being involved in a fatal crash, with approximately 30% of fatal crashes being the result of driving under the influence (Australian Transport Council 2006). Fatigue is also a major contributor to fatal crashes, as drivers suffering from fatigue make little or no attempt to avoid the crash which results in severe crashes. The problem in calculating the amount of crashes caused by fatigue is at it is very difficult to determine it was the cause, due to it only being observed as no test can be done (Australian Government 2004). Inattention is fast becoming a major cause of accidents on roads. It may not cause as many fatal crashes as the other factors but the amount of crashes it causes is significantly higher. This can be seen in figure 2.5. Inattention distractions can be classified into two broad groups: Technology-based (such as phone, navigation, audio and video) and non-technology based (such as smoking, talking to passenger/s, eating and drinking) (Queensland University of Technology 2008a).

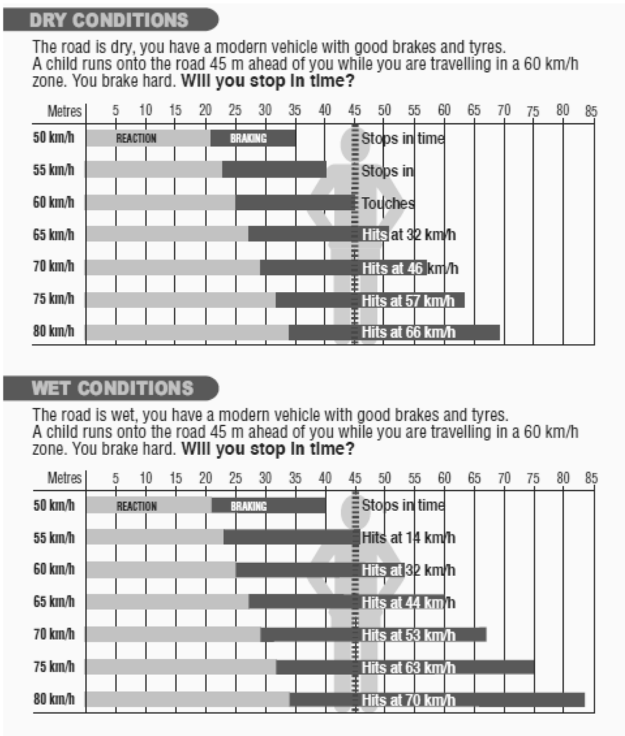

Figure 2.4 Effects of Speeding on Stopping Distance

Source: Australian Government 2004

Factors	Fatal	Serious Injury	Minor Injury	Non-Injury	Cost (A$)
Inattention	38	933	2679	2559	495,237,018
Alcohol/Drug	94	475	491	666	359,808,830
Speed	48	239	257	402	182,728,570
Fatigue	28	295	347	479	174,203,186

Source: Crash statistics obtained from Web Crash 2 on 5/8/02; costs computed using per unit value provided by BTE(2000).

Figure 2.5 Major Contributors to Crashes in Queensland 2000

Source: Queensland University of Technology 2008c

2.5.2 Road Environment

Designing a safe road environment is an essential part of creating a safe transport system. Recognising the realities and limitations of human decision making is a key aspect to create such an environment. The road environment should provide no surprises in road design or traffic control as well as provide a controlled release of relevant information and repeated information where appropriate (Austroads 2009).

2.5.3 Vehicle

The types and interaction of vehicles within the road network vary extensively, and road design therefore needs to consider the characteristics of the vehicles using the road. The main characteristics of the vehicles are manoeuvrability, visibility, cornering and braking. While local streets are primarily only used for residential traffic, they still need to be designed for larger vehicles such as emergency and delivery vehicles.

Reducing the amount and severity of crashes has been greatly improved in respect to vehicle safety with the advancement of technology, with the implementation of safety devices such as seat belts (originating from aircraft in WWII), airbags, crumple zones, Anti-lock Braking Systems (ABS) and Electronic Stability Control.

2.6 Limitations of Reported Crash Data

It is important to recognise that while there are standards in place to ensure a consistency and quality to the data that is recorded at crashes, there are still limitations to the recorded data. Some of these limitations are:

- **Under reporting of crash data –** although significant attempts are made to collect and record all relevant crash data, not all non-fatal crashes make their way to the relevant crash database.
- **Systematic reporting bias –** this bias can result from the regulations or police covering the reporting of crashes. Reporting criteria may be different between jurisdictions, resulting in crashes not being comparable.
- **Random reporting bias –** it is well established that crashes involving children cyclists, pedestrians and minor injuries are substantially under reported. A similar situation applies to crashes involving illegal activities, such as underage driving.
- **Subjective bias** - some crash forms require an assessment of possible contributing causes of the crash. This adds a subjective element as the range of possible responses to the question depends on the recorder's experience.
- **Reporting errors –** it is important to recognize the circumstances under which a police officer obtains information to complete a crash report. There will often be more pressing matters at a crash scene. Officers may not have local knowledge, so some data items may be inadequately or wrongly recorded. Crashes do not always fit 'standard' formats and there may not be the motivation to fill out the form so only the minimum is recorded.
- **Coding errors –** these can occur throughout the process from filling out the crash report form to the data entry at the computer terminal. They are unlikely to be revealed unless the data is used for detailed investigation at individual sites.
- **Location errors –** the location may be imprecise or wrong in the original police report form and this will be carried through into the database.
- **Discontinuities over time –** definitions or interpretations of field data may be changed over time by those responsible for coding and reporting so that data from one period cannot be compared with that of another.

(Austroads, 2009)

2.7 Crash Coding

The most important piece of information to help understand what happened during a crash is the Road User Movement (RUM) or crash type. The RUM code was introduced in Victoria in 1986, though is now more often known as the Definitions for Coding Accidents (DCA) codes in Australia or Vehicle Movements Code (VMC) in New Zealand (Austroads, 2009). Figure 2.6 shows the DCA code table.

The crash-type is based on the traffic movements leading up to the collision. Why and how the participants collide is not of significance and the relative blame of the participants also plays no part in determining crash-types. With regard to movements, driver or pedestrian intent as well as actual movement can be used in determining the crash-type.

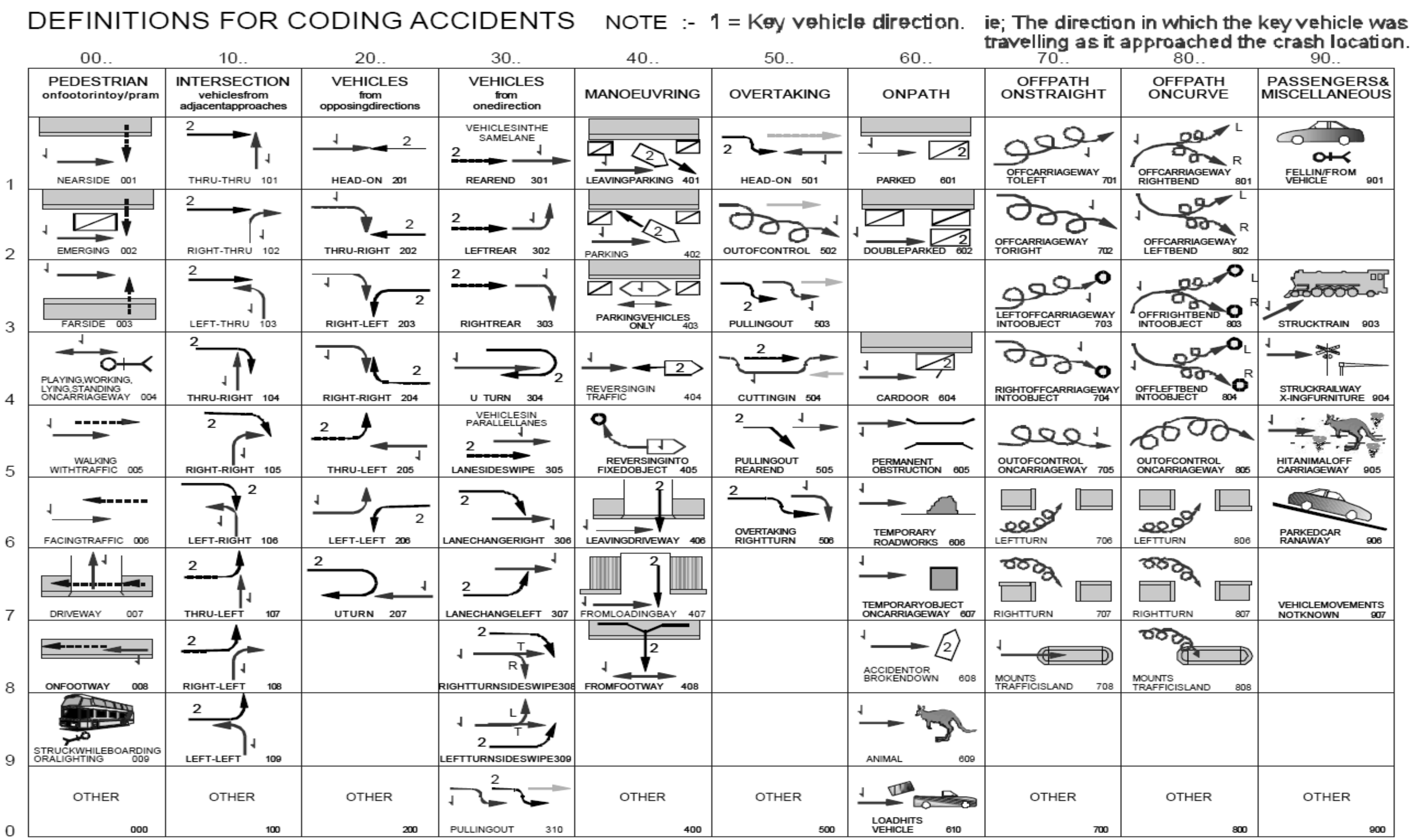

Figure 2.6 DCA Code Table

Source: (Data Analysis Unit 2008)

Chapter 3 The 50 km/h Speed Limit Overseas and in Australia

3.1 Introduction

Before conducting a formal analysis of the crash data for the Toowoomba area, a review of earlier studies completed by recognised research bodies done on behalf of the different Australian state governments, and national transport authorities in different countries around the world was completed.

3.2 Overseas

Before the 50km/h was introduced in any Australian state, it had already been implemented in most developed countries. Some of these countries included Austria, Belgium, Canada, Denmark, Finland, France, Great Britain, Greece, Hong Kong, Hungary, Ireland, Israel, Italy, Korea, Luxembourg, New Zealand, Norway, Portugal, Spain, Switzerland and all states of the United States of America, (Austroads 1996). Some of these countries don’t have a 50km/h speed limit as such, they have urban speed limits of 30mp/h which equates to approximately 48km/h.

A study done by Preston (1990), found that the European countries and American States that had implemented an urban speed limit of 50km/h had a 30% lower death rate for pedestrians involved in crashes aged 25 – 64, than countries with an urban speed limit of 60 km/h.

Some results of studies performed by other countries and their respective authorities yielded consistent results. Fatal crashes in Norway decreased by 45% after the reduction of urban speed limits to 50km/h. When Denmark reduced its urban speed limit in 1985 from 60 km/h to 50 km/h, total crashes were reduced by 9%, fatal crashes by 24%, serious crashes by 7% and minor injuries by 11%. When the lower speed limit was in introduced in Zurich, Switzerland, all crashes involving pedestrians decreased by 20% and pedestrian fatalities fell by 25%. When introduced in France, 14,500 casualty crashes and 580 fatalities (3%) crashes were avoided in the first 2 years (O'Hare 2005).

It was these kind of results showing a significant reduction in crashes and fatalities from crashes that lead Australia to start considering lowering its urban speed limit, and the 50 km/h urban speed limit eventually being introduced to all areas of Australia excluding one territory.

3.3 Australia

As Australia is a large country with a small population by international standards, having a population density of 3 people per km^2 (the third lowest population density in the world) it faces issues with urban sprawl. In the following section of the chapter, how, when and where the 50 km/h urban speed limits were introduced to the different states and territories of Australia will be outlined, considering that each state and territory has its own transport authority. A discussion of the results will also follow.

3.3.1 Queensland

The default 50 km/h speed limit was first introduced on local streets in South East Queensland on the 1st of March 1999, as a trial implementation for the rest of Queensland, as south-east Queensland makes up approximately 60% of Queensland's population. The default urban speed limit was then introduced to the rest of Queensland on the 1st of February 2003.

Selection of 50 km/h areas

In Queensland, the local government authorities have the legislative authority to determine the speed limits on their roads. To prevent inconsistencies in the speed zoning of streets in the different local government areas, the default 50 km/h speed limit was applied in accordance with the Queensland Manual of Uniform Traffic Control Devices (MUTCD) for local streets. The MUTCD defines local streets with the following characteristics:

- a carriage way width of 8-10 metres or less
- maximum 85th percentile speed of 59 km/h
- absence of centreline markings
- located in built up areas which typically have block sizes up to 2000 m^2
- a maximum AADT of 3,000 (i.e services up to 300 dwellings)

Donaghey and Ram (2000) noted that these typical characteristics were provided for guidance only, not strict compliance. If the function of the street was only for local access it was still zoned 50 km/h even though it may not meet the specification. Some motorists complained that they incorrectly assumed that a street with a centreline was 60 km/h. To counteract this problem, local government will allow centrelines on 50 km/h roads to fade out, unless required for safety (Haworth et al. 2001).

Signage

The 50km/h speed limit was introduced as the default speed limit on local streets in Queensland, meaning the streets did not need to be signed, unless the speed limit was 60 km/h or above. The 50 km/h limit was also applied on some streets other than local streets such as strip shopping centres, foreshores and where the physical environment supports the lowered speed limit. In these particular cases the 50 km/h speed limit is signed (Haworth et al. 2001). An example of these in Toowoomba would be part of Russell Street, Neil Street, Victoria Street and Ruthven Street/ New England Highway, as they pass through the CBD of Toowoomba.

Implementation

Before the speed limit was implemented in Queensland, a mass media campaign was undertaken where television commercials and radio commercials were aired informing the public about the speed reduction campaign and its benefits. Newspaper articles and a brochure were published, with the brochure being mailed to households. There were also educational displays at shopping centres, community functions and marketing events aimed at visitors from interstate and overseas.

The default 50 km/h speed limit on local streets was implemented on the 1st of March 1999 in South-East Queensland and the 1st of February 2003 for the rest of Queensland. They both had amnesty periods of 3 months, with full enforcement beginning on the 1st of June 1999 and 1st of May 2003 respectively. During the amnesty periods, drivers would be pulled over and warned if exceeding 50 km/h and they would still be prosecuted if found speeding excessively or dangerously.

Findings

In a study done by Monash University Accident Research Centre (MUARC) of the 50 km/h speed limit in south-east Queensland, it was found that there was an 88% reduction in fatal crashes, 25% reduction in all casualty crashes, 20% reduction in property damage crashes and a 22% reduction in all reported crashes (Hoareau et al. 2002). This analysis was done using data from 62 months of pre implementation and 39 months of post implementation crash data. The average reduction in 85th percentile speed for South-East Queensland was 2.2km/h.

A study done by MUARC evaluating the effectiveness of the 50 km/h speed limit in regional Queensland revealed a reduction of 13.5% of all crashes, 24.9% of which were serious casualty crashes (severity levels 1 and 2) and 19.3% of all fatal, hospitalisation and medical attention crashes combined (severity levels 1,2 and 3) (Newstead et al. 2005), using data from January 1998 to May 2004.

3.3.2 New South Wales

In October 1997, 26 New South Wales (NSW) Local Government areas took part in a 3 month trial of the 50 km/h urban speed limit. Then on the 3rd of June 1998, the NSW Minister for Roads and Transport invited all of the NSW local councils to implement the 50 km/h urban speed limit throughout their areas (Haworth et al. 2001).

Selection of 50 km/h Areas

The 50 km/h urban speed limit is designed for local streets in built up metropolitan areas and country towns. The streets in which the speed limit would be applied to in each council were determined by signing and hierarchy plans. The plans were developed with the local council and RTA working together, to ensure consistency throughout the councils participating in the speed limit reduction.

Signage

In partnership with councils, the RTA implemented several strategies to minimise the excessive use of signs. Networks of streets with limited access are posted with area signs, supplemented by repeater signs or pavement markings. Once the council had installed all the signs and markings for their area, the RTA conducted an audit.

Implementation

In 1997, 26 NSW LGA's took part in a 3 month trial of the 50 km/h urban speed limit, from the 1st of October to the 31st of December 1997. Due to the success of the trial on the 3rd of June 1998, the NSW Minister for Roads and Transport invited all NSW local councils to participate in the implementation of the 50 km/h local street speed limit (Haworth et al. 2001). As of December 2002, 141 councils out of the 171 and 2 communities had implemented the lower speed limit, covering 90% of the state's population (National Road transport Commission 2003). In November 2003, the speed limit was introduced state wide.

The public education campaigns used in LGA's implementing the new speed limit were:

- television and radio commercials
- shopping centre displays
- laminated maps showing areas of the 50 km/h zones in shopping centres and schools
- distribution of fridge magnets, stickers and brochures
- newspaper advertisements published into the five (5) most frequent used languages in the area

(New South Wales Road Traffic Authority, 2000)

Findings

A major evaluation was conducted from June 1998 to April 2000 to determine the effectiveness of the initiative. The evaluation found that there was a decrease in all accidents by 23%, all casualty crashes by 19% and all crashes involving pedestrians by 20%. The average reduction in 85^{th} percentile speed for NSW was 1.2km/h.

3.3.3 Victoria

The default residential speed limit was reduced to 50 km/h from 60 km/h on the 22^{nd} of January 2001 in Victoria.

Selection of 50 km/h Areas

The 50 km/h speed limit was introduced as the default speed limit for roads in built up areas in Victoria. Therefore any street without a speed sign in a built up area has a speed limit of 50 km/h. A built up area is defined in the Australian road rules as "*in relation to a length of road, means an area in which there are buildings on land next to the road, or there is street lighting at intervals not over 100m for a distance of at least 500 metres or, if the road is shorter than 500, metres for the whole road*" (Haworth et al. 2001).

Signage

With the implementation of the 50 km/h limit, each local government was responsible for the installation of the speed signs in their area, but are required to get approval from Vic Roads before installing them. The regulatory impact statement estimates that there would be approximately 16,000 signs installed, and that these signs would be installed along collector roads in residential areas to ensure that traffic would not be delayed. It was also estimated that 100 advisory signs needed to be installed across the state to remind visitors and locals of the 50 km/h speed limit (Haworth et al. 2001).

Implementation

On the 22nd of January 2001, the default residential speed limit of 50 km/h was introduced state-wide. Vic Roads implemented an educational campaign at the time of the implementation of the 50 km/h speed limit. Their campaign aimed to ensure that all residents of Victoria were aware of the new default speed limit of 50 km/h unless signed otherwise. Their campaign mainly focused on radio advertising and printed media and information was also available on their web page. The Transport Accident Commission also mounted a media campaign with television advertising.

Findings

A study conducted by MUARC using crash data from January 1996 to December 2003 found that there was a 52.9% reduction in fatal crashes, a 13.2% reduction in all casualty crashes and a reduction of 20% of all crashes involving pedestrians. The average reduction in 85th percentile speed for Victoria was 1km/h.

3.3.4 Western Australia

The default residential speed limit was reduced to 50 km/h from 60 km/h on the 1st of December 2001 in Western Australia (WA). The default speed limit introduction for WA was based on the implementation methods used by Victoria and South-East Queensland. It was introduced as a default speed limit and as such only streets with a speed limit other than 50 km/h were signed. There was no trial period as there had already been extensive studies done on the benefits of the speed reduction in NSW, QLD and Victoria. When introduced in WA, similar public educational campaigns were used as in the other states as they had proven to be effective, though when introduced there was no amnesty period.

Selection of 50 km/h Areas

The speed limit reduction was applied to all local streets in 'built-up' areas in WA. The selection of which roads to apply the speed limit to for WA focused on what roads the default speed limit would not be applied to, these were:

- primary distributors (ie freeways and highways)
- district distributors (ie major traffic routes)
- dual carriageways
- roads that have no direct access from properties
- roads that are not built-up or have no street lighting

(Road Safety Council 2001)

Findings

An evaluation of the speed limit reduction for WA was carried out by MUARC using crash data from December 1996 to November 2003. The results of the study showed a reduction of 20% in all crashes and a 51% reduction in crashes involving pedestrians for metropolitan Perth. These were the main results that were found to be statistically confident. The average reduction in 85^{th} percentile speed for Western Australia was 0.8km/h.

"The primary problem was a pragmatic one in that it proved impossible to reliably identify the roads that changed from a 60 km/h to 50 km/h speed limit, following the change in default urban speed limit, from the road inventory information that existed in Western Australia at the time of the study. Secondly, there was also some concern about how unaffected the 60 km/h roads were by the default speed limit change. Anecdotal evidence suggested that there was an element of confusion amongst the public as to where the 50 km/h default limit applied, particularly because the roads on which the new lower default limit applied were generally not indicated by the placement of speed zone signs. If this

was the case, it was possible that motorists also adopted lower travel speeds on roads with speed limits above 50 km/h, and particularly on roads zoned 60 km/h due to their physical similarities." (Hoareau & Newstead 2004, p44).

3.3.5 South Australia

On the 1st of March 2003, the default speed limit was introduced in South Australia (SA), reducing the speed limit from 60 km/h to 50 km/h.

Selection of 50 km/h Areas

For the selection of roads to be zoned 50 km/h in SA, all roads were zoned 50 km/h, and local government authorities were able to nominate, with supporting evidence, which of their roads, if any, should remain at 60 km/h to the Department of Transport and Urban Planning (DTUP) (Kloeden, Woolley & McLean 2004). As the government regulatory body however, the DTUP had the final say and could exercise its authority to determine the final speed limit on these roads. The Adelaide City Council decided to adopt 50 km/h throughout most of its central city road network as did some large rural towns (Kloeden, Woolley & McLean 2004).

Signage

The DTUP initially installed approximately 4,000 60 km/h signs on urban arterial roads for which it was responsible. The initial philosophy was to have signs repeated at a maximum of one kilometre intervals and at the intersections of major roads. The DTUP installed more signs in August and September of 2003 and reduced the spacing between 60 km/h signs to 600 or 700 metres (Kloeden, Woolley & McLean 2004).

The speed limit change generated some complaints from the community, particularly with regard to confusion about what the speed limit is on a given road. In response to this, DTUP provided reminder signs seen in figure 3.1. These signs were installed by local councils on roads with the highest number of complaints.

Figure 3.1 Reminder Signs

Source: Kloeden, Woolley & McLean 2004

Implementation

On the 14th of February 2003, the SA government implemented a mass media campaign using radio and television to promote the new 50 km/h urban speed limit being introduced on the 1st of March. Once the urban speed limit began there was a three month amnesty period on roads where the speed limit changed (Kloeden, Woolley & McLean 2004).

Findings

An initial evaluation of the default 50 km/h speed limit was conducted by the University of Adelaide's Centre for Automotive Safety Research (CASR) using crash data from January 1994 to June 2004. This report found there was a 19.8% decrease in casualty crashes on roads where the speed limit was reduced from 60 to 50 km/h, and a reduction of 4.6% on roads that remained 60 km/h in the year following the introduction of the default 50 km/h speed limit. The average reduction in 85th percentile speed for South Australia was 1.4km/h.

A second study was undertaken in 2006 using data from March 1994 to February 2006. This report compared data from three years before the implementation to three years after the implementation of the default urban speed limit. The report found that there was a 23.4% decrease in total crashes that occurred on streets where the speed limit decreased to 50km/h, and a 16.4% decrease in all crashes on streets where the speed limit stayed 60 km/h (Kloeden, Woolley & McLean, 2006).

3.3.6 Australian Capital Territory

In April and March of 2003, the Australian Capital Territory (ACT) adopted the default speed limit.

Selection of 50 km/h Areas

The ACT decided to adopt a unique street selection process. In the ACT the 50 km/h speed limit was introduced on all local and collector streets in the residential areas, as specified by the ACT Territory Plan. Speed limits on roads in the parliamentary zone, commercial zones and industrial areas stayed the same.

Signage

The ACT implemented the 50 km/h residential speed limit as a default speed limit, therefore all streets without a speed limit sign were 50 km/h. Areas with 50 km/h streets are indicated by “50 km/h Area” signs at entry points into the area and “End 50 km/h Area” signs at exit points out of the area. Within the designated 50 km/h residential areas, 40 and 60 km/h speed zones exist, but are sign posted (Green, Gunatillake & Styles 2003).

Implementation

A 50 km/h speed limit was approved in the ACT during December 2000 and was introduced in March 2001 as a two-year trial. All local and collector streets in residential areas were zoned 50 km/h, as per the ACT Territory Plan. In February 2001, ARRB Transport Research (ARRB) was commissioned by ACT’s Department of Urban Services to conduct an evaluation of the default 50 km/h residential area speed limit. After viewing the findings, the default 50 km/h residential area speed limit was finalised and approved.

Findings

The ARRB used data from three years before the speed limit was introduced and compared it to data recorded for two years after. The evaluation found that there was a decrease in total crashes by 9%, a reduction in casualty crashes by 32% and a reduction in property damage crashes by 7%. A Cost-Benefit Analysis (CBA) was also done, finding that there was a saving of $3,489,000, giving a CBR of 8.2. The average reduction in 85th percentile speed for the Australian Capital Territory was 1.8km/h.

3.3.7 Tasmania

Tasmania introduced the 50 km/h speed limit reduction to local roads on the 1st of May 2002, as a default urban speed limit. A public education campaign was undertaken with the rule of “NO SIGNS, DRIVE 50” (Department of Infrastructure, Energy & Resources 2007). There was no trial period as significant crash reductions had previously been observed in other states.

Findings

Tasmania has not done a formal evaluation of the effectiveness of their speed limit reduction.

3.3.8 Northern Territory

Northern territory still has a speed limit of 60 km/h on urban roads.

3.4 Summary and Comparison of Australian States & Territories

Table 3.1 displays all the recorded average reductions in 85th percentile vehicle speed for the different evaluations. Table 3.2 summarises the results found by the studies completed by different transport authorities and research facilities in Australia, making it easier to compare when and how the lower speed limit was introduced, who completed the study and what results were found. The blank sections can be explained by the individual studies not testing all of the same categories.

Location	Reduction in 85th Percentile Speed (km/h)
SE QLD	2.2
NSW	1.2
ACT	1.8
Victoria	1
Tasmania	N/A
Northern Teritory	N/A
South Australia	1.4
Western Australia	0.8

Table 3.1 Reduction in 85th Percentile Speeds

Study Area	50 km/h Start Date	Results				Implementation Type	Study done by
		All	Fatal	Casualty	All Pedestrian		
South-East QLD	1st of March 1999	22%	88%	23%		Default	MUARC
Regional QLD	1st of February 2003	13%	19%			Default	MUARC
NSW	October 1997	23%		19%	20%	Select towns, signed	RTA
Victoria	22nd of January 2001		52.9%	13.2%	20%	Default	MUARC
WA	1st of December 2001	20%			51%	Default	MUARC
SA	1st of March 2001		40%	23.4%	20.6%	Default	CASR
Tasmania	1st of May 2001	No Evaluation Done				Default	N/A
ACT	March 2001	9%		32%		Select Areas	ARRB
NT	Still has a default speed limit of 60 km/h						

Table 3.2 Crash Reductions Found by Other Studies Done within Australia.

Chapter 4 Study Area

4.1 Toowoomba

Toowoomba is located approximately 145 km west of Brisbane, and has an area of approximately 117 square kilometres. The 50 km/h default urban speed limit was introduced in Toowoomba on the 1st of February 2003 along with regional Queensland. Toowoomba is zoned as being part of South-East Queensland, though it was not included in the 50 km/h trial which was implemented in built up areas of South-East Queensland on the 1st of March 1999.

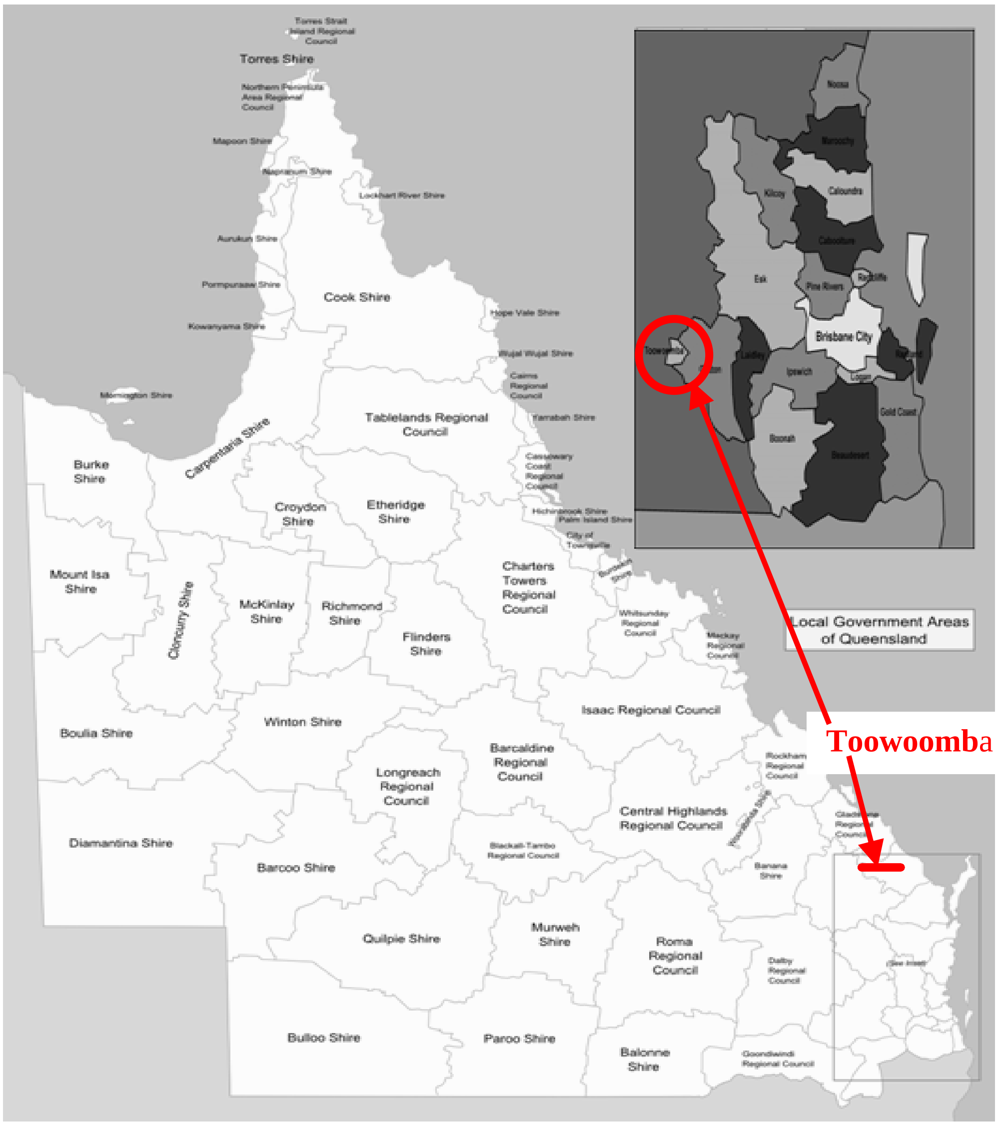

Figure 4.1 Queensland Local Government Areas

4.2 Toowoomba's Road Network

Toowoomba's road network consists of 725 km of roads which are categorized by, its hierarchy and its speed limit as seen in figures 2.1 and 2.2. Vehicles travelling to, from or through Toowoomba have use of three (3) main highways. These highways include the New England Highway (running north-south through Toowoomba and is controlled by the State Government), the Warrego Highway (running east-west through Toowoomba with the east leading to Brisbane), and the Gore Highway to the south-west. There are two (2) highways which are controlled by the Federal Government. The rest of the roads in Toowoomba are controlled by the Toowoomba Regional Council (TRC). Of the 725km of roads in Toowoomba, 670km or 92% are controlled by TRC, 20km or 3% are controlled by the state government and 35km or 5% are controlled by the Federal Governments, as seen in figure 4.2.

Using the 4 road classifications of the Road Hierarchy system discussed in section 2.4 and seen in Figure 2.2, local streets make up 82% of the total roads in Toowoomba or 595km, collector streets make up 7% or 49km, sub-arterial roads being 4% or 32km and arterial roads make up 7% or 48km. Streets with a speed limit of 50km/h seen in Figure 2.3 only make up 65% (471km) of the 725km of roads in Toowoomba.

4.3 Population

Using data from the Australian Bureau of Statistics, national surveys found that on average from 1998 to 2007, Toowoomba's population grew 1% annually with a population of 96,326 in 2007.

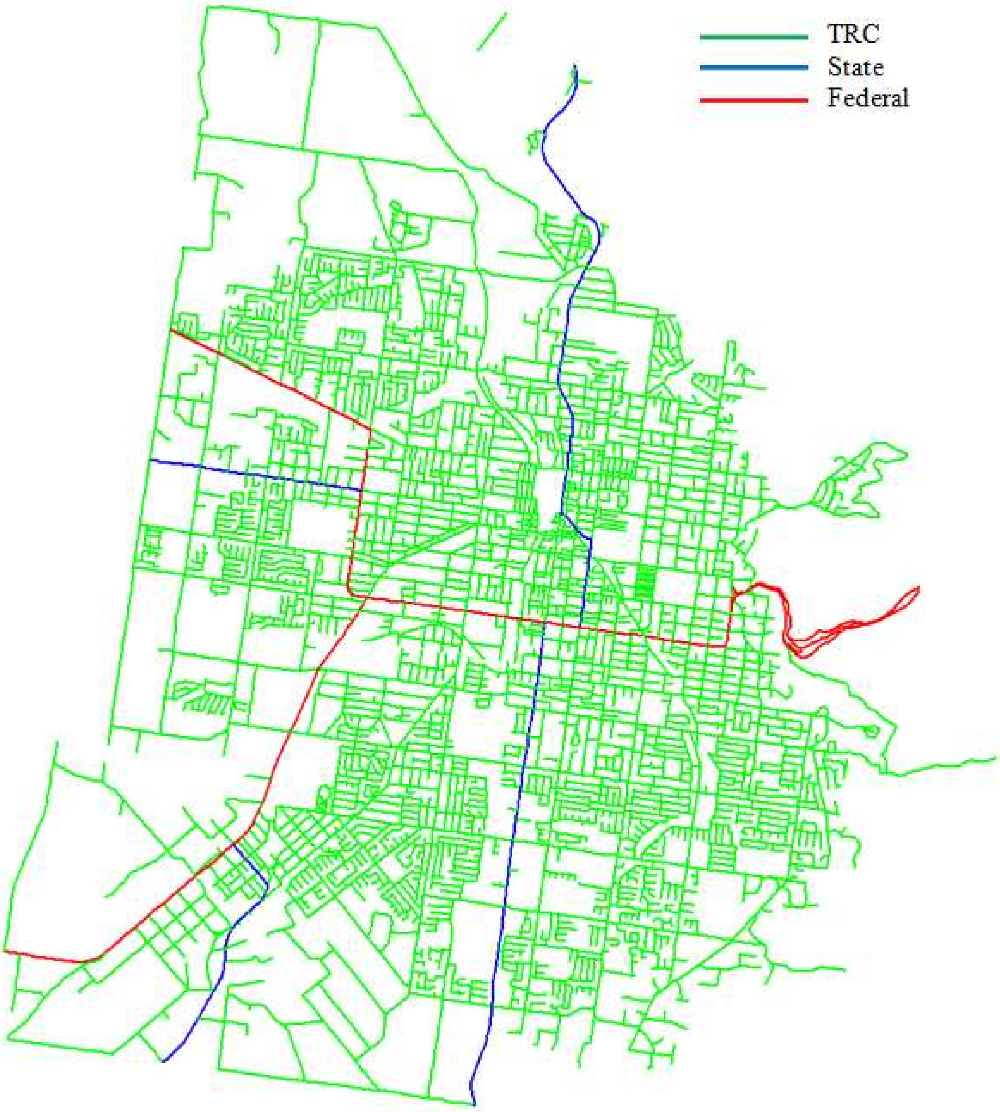

Figure 4.2 Road Authorities

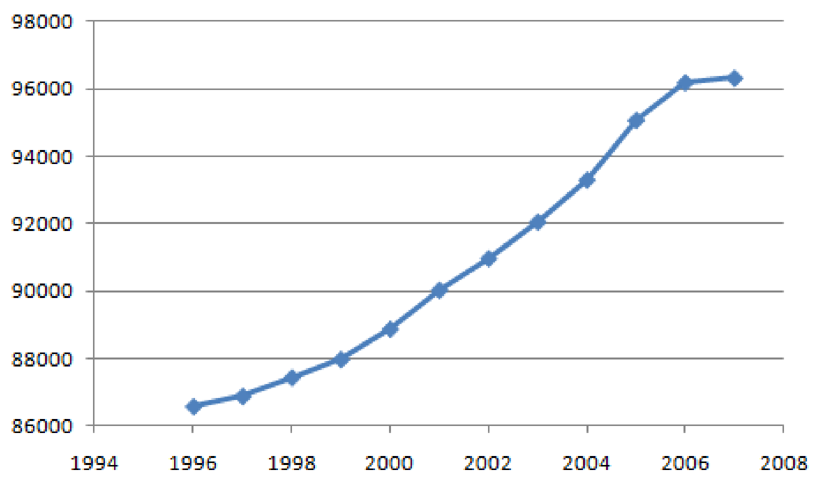

Figure 4.3 Toowoomba's Population Growth

Chapter 5 Project Methodology

5.1 Introduction

The project methodology discussed in this chapter will include methods and sources of data collection, how the data was refined and the useful information extracted, the methodology used to analyse the data, any limitations of the data and difficulties that occurred while analysing the data. The results of the data analysis will be discussed in detail in chapter six.

5.2 Data

The data used to analyse the effectiveness of the 50km/h speed limit was collected from two main sources; Queensland Transport Data Analysis Division and Toowoomba Regional Council. The first lot of data requested and obtained was from Queensland Transport Data Analysis Division, using the WebCrash website and Crash Stats Request Form. Once the crash data was received, the Toowoomba Regional Council was contacted and information relating to the road network and street speeds was requested.

5.2.1 Crash Data

The crash data obtained from Queensland Transport was from 1998 to 2007, five (5) years before and after the implementation of the 50km/h default urban speed limit in Toowoomba. The crash database used by Queensland Transport is made up of all crashes reported by the Queensland Police Service and the data that was received consisted of 6,182 crash incidents for the Toowoomba area. A sample of this can be seen in Appendix B.

The initial crash data attained from Queensland Transport contained a substantial amount of information relating to each crash that occurred in Toowoomba such as when it occurred, crash severity, crash nature, contributing circumstances and much more as seen in Appendix B. Possibly the most important information was missing however; the location of the crashes. Queensland Transport was contacted again and it was discovered that special permission had to be attained from a senior member of the data analysis unit to attain the street name/s that the crashes occurred on. Exact crash locations were not able to be attained as this level of information is only available to Queensland Transport and Main Roads employees, as well as organisations conducting the research on behalf of the Queensland Department of Transport and Main Roads.

5.2.2 Toowoomba Regional Council Data

The data received from Toowoomba Regional Council was a map showing the Toowoomba streets and their associated speed limits as seen in Appendix C. As the map was fixed in size and zooming in would have distorted the image, MapInfo files for the Toowoomba road network were purchased from TRC. Included in these files was the associated database which provided all the information for each road, a sample of this can be seen in appendix D. Traffic count data was also attained from TRC which can be found in appendix E.

5.3 Methodology

The following method was used to evaluate the effectiveness of the 50km/h default urban speed limit in Toowoomba, after initial literature reviews. For the analysis, no assumptions or predictions were made as to whether the 50km/h default urban speed limit increased, decreased or had no effect on the amount and severity of crashes.

5.3.1 Crash Data Analysis

The crash data analysis was conducted using a standard quasi-experimental study design, in which the control chart method was used. An assessment by Newstead (2000) on the "relative performance of the control chart methodology in application to road safety program evaluations" found that "the control chart method of quasi-experimental study design analysis will yield accurate point estimates of crash effects due to road safety program introductions when applied in well designed real world studies". The control chart method was selected because of the simplicity of use, the results displayed, the accuracy of the results when used on real world studies not theoretical analysis and the fact that the required software is readily available and does not require expensive and complicated software.

The control chart method of analysis uses the selection of treatment and control crashes, where a linear regression line is fitted to the control series of data and extrapolated for the selected time period. The extrapolated values of the control data were then compared with the observed values of the treatment data giving a percentage reduction in crash frequency (Newstead 2000).

To evaluate the effectiveness of the 50km/h default urban speed limit in Toowoomba, treatment and control groups were identified. The treatment group was crashes that occurred on streets where the speed limit changed to 50km/h after the default urban speed limit was implemented. The control group was defined as crashes that occurred on streets where the speed limit changed to 50km/h because of the implementation of the default urban speed limit, but before it was introduced.

The initial method for identifying crashes that met the requirements of the control and treatment groups was to identify crashes that occurred after the 1st of February 2003, where the speed limit was recorded as 50km/h by Queensland Transport. The street names were then used to locate streets with the same name that occurred before the default urban speed limit was introduced. While evaluating this data, it was identified that if a crash did not occur on a street after the default urban speed limit was introduced but did before, the data would be excluded as it would lead to biased results. This error in data was also noted by MUARC when they worked with data from Queensland Transport.

Toowoomba City road network database and corresponding MapInfo files were purchased from Toowoomba Regional Council as part of this project to allow an in-depth analysis of the crash locations to be undertaken. Using this data, crashes that occurred on streets where the speed limit was 50km/h were able to be accurately identified. The following criteria were established for crashes that occurred in 50km/h speed zones:

a) Crashes needed to occur on streets where the entire length of the street was zoned 50km/h.

b) Crashes occurring at intersections needed to have all intersecting roads zoned at 50km/h.

c) Crashes that occurred on roads where the speed limit changed at different sections were excluded, as exact crash locations along these roads were unable to be attained from Queensland Transport due to privacy issues.

During the analysis, it was discovered that some of the crashes in were incorrectly zoned, with crashes occurring along solely 50km/h streets or at intersections of two solely 50km/h streets being classed as having a speed limit of 60km/h. There were also some cases of crashes in streets with a speed limit of 60km/h and above being classified as having a speed limit of 50km/h. Examples of some of these incorrectly zoned records these can be seen in Table 5.1, examples from 2007 were selected as they are the most recent data.

When	Street 1	Street 2	Recorded Speed Limit	Actual Speed limit	Reference Figure
November, 2007	Cathro St	N/A	60	50	5.2
December, 2007	Little St	Victoria St	60	50	5.3
December, 2007	Anzac Ave	N/A	50	60+	5.4

Table 5.1 Falsely Zoned Crashes.

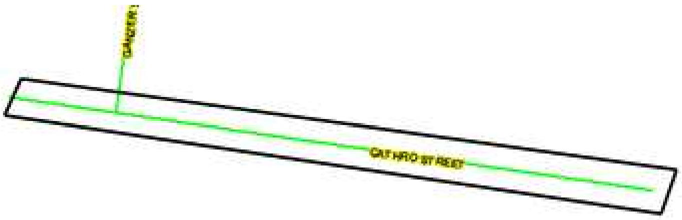

Figure 5.1 Cathro Street

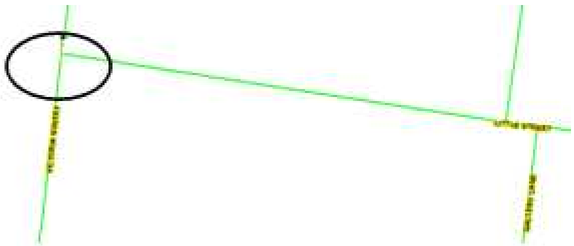

Figure 5.2 Intersection of Little and Victoria Street

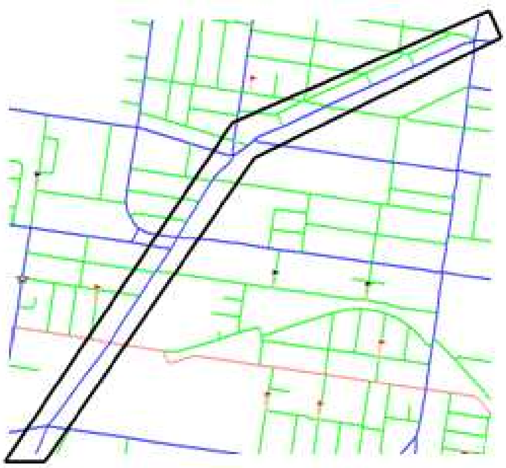

Figure 5.3 Anzac Avenue

Once all the crash data had been refined into treatment and control groupings and then checked to ensure that no data was excluded or accidentally included, it was ready to be sorted into different groupings for comparison. The Government's primary purpose for implementing the 50km/h default urban speed limit was to reduce the number and severity of crashes, as well as make local streets a safer place. Initial analysis focused on total number of crashes and number of crashes in each severity level. The total number of crashes that involved pedestrians was also analysed against the different severity levels. To allow for Toowoomba's increasing population, all crashes were scaled against a base population of 10,000 people for that particular year. Toowoomba's yearly population from 2003 to 2007 was attained from the Australian Bureau of Statistics.

5.3.2 Frequent Crash Site Investigation

Once the crash data analysis had been completed, streets and intersections where the most crashes occurred were identified. Physical inspections were carried out at each of these sites.

The site inspections were carried out by firstly identifying the site, then conducting a preliminary investigation using Google Maps Street View to get an initial perspective of the site and identify any possible hazards. Due to these sites being identified as hazardous locations where crashes are more likely to occur, it was decided to use pictures from Google Maps. Using this tool, it was possible to obtain photographs which provide a view of what a driver would actually see if they were driving down the road, without having to physically stand in middle of the road to take photos which would be a safety hazard without the appropriate signage.

Physical site inspections were also carried out by driving along the identified street in both directions, or if it was an intersection, by driving through the intersection in both directions along all streets of the intersection. Due to the nature of these sites being accident prone areas, a fellow engineering student was asked to assist in the site investigations for safety reasons. The other student drove the vehicle for the site inspections, allowing him to direct his full attention to the road and other vehicles. This made thorough observations, note taking and identification of hazards possible, allowing site inspections to be undertaken with minimal risk to all those involved.

5.3.3 Speed Survey Analysis

A speed survey analysis was carried out by obtaining traffic count data from TRC for streets where the speed limit decreased from 60km/h to 50km/h, due to the implementation of the 50km/h default urban speed limit.

The traffic count data attained was recorded for 24 hours a day for 7 consecutive days. The traffic count data received was for 5 sites in Toowoomba. Three counts occurred for the same week each time and the remaining 2 were recorded the following week. It is assumed that Toowoomba Council only had access to 3 traffic counting devices so all 5 sites could not be tested at the same time. s the traffic counts were only a week apart they were considered to have occurred close enough to be treated as occurring at the same time and grouped for comparison. For the purpose of this report, the traffic counts occurred in November 2002, March 2003, August 2003 and February 2003. A speed survey analysis was then conducted using the traffic count data to determine the change in 85th percentile speed, the percentage of vehicles travelling at the different speed groupings and the percentage of vehicles exceeding the speed limit.

Chapter 6 Discussion and Results

6.1 Introduction

Having refined crash data into treatment and control groups, analysis of data could begin. The following sections discuss the results and trends observed for crash data and speed analysis. Maps showing all the fatal and hospitalisation crashes before and after the 50km/h speed limit can be seen in appendix F and G.

6.2 All Crash Data

The tables showing all calculated values can be viewed in appendix H and I, the results of which being discussed in detail in this section of the report.

6.2.1 Total Crashes

Figure 6.1 shows the total amount of crashes that occurred on streets with a 50km/h speed limit in Toowoomba from 1998 to 2007. Looking at figure 6.1, there does not appear to be a decreasing trend in the amount of crashes occurring after the 50km/h speed limit was introduced in 2003. There is a slight decrease in 2003 when the 50km/h speed limit was introduced and then the increasing trend continued in 2004 and 2005, with a significant decrease occurring in 2006.

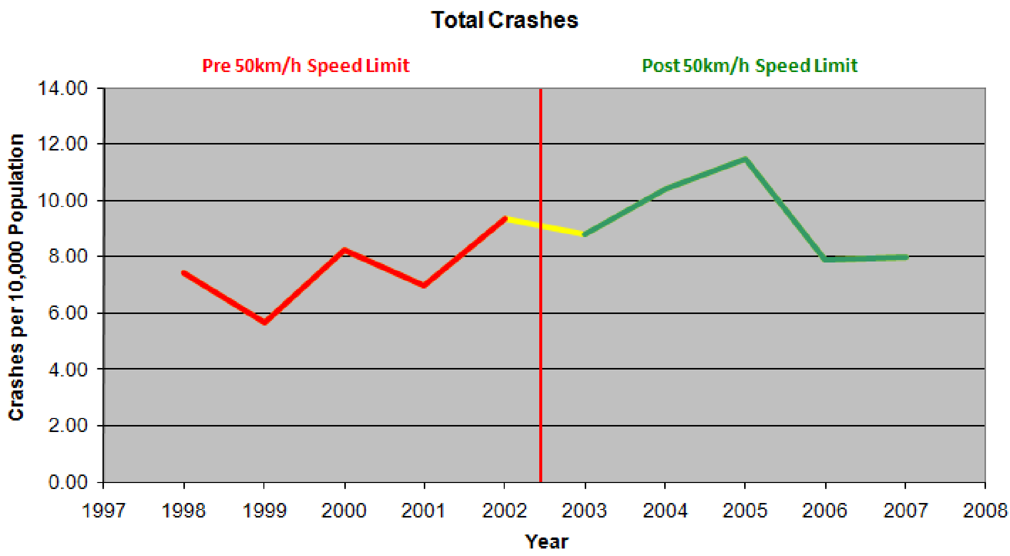

Figure 6.1 Total Crashes in Toowoomba

Using the control chart method, a linear regression line was fitted to the control data and extrapolated to 2007, where the extrapolated control values could be compared with the observed treatment group crashes as seen in figure 6.2. These extrapolated values were totalled and compared with the total for the observed results from 2003 to 2007 and a reduction/increase calculated. These values can be seen in table 6.1. The comparison yielded a reduction of 8% for all crashes occurring on 50km/h streets in Toowoomba.

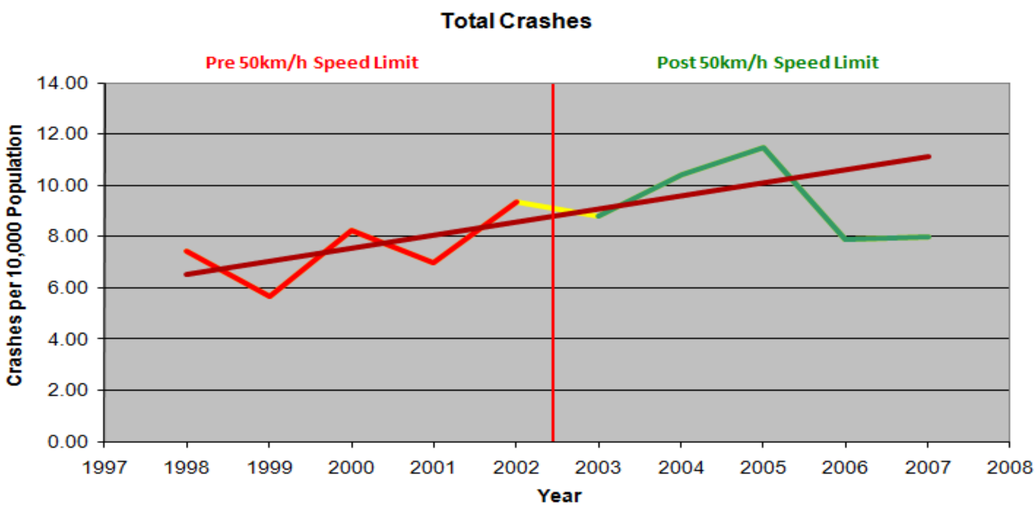

Figure 6.2 Fatal Crashes in Toowoomba Linear Regression line

	Total Crashes per 10,000 population	
Year	Observed	Extrapolated
2003	8.80	9.04
2004	10.40	9.55
2005	11.46	10.07
2006	7.90	10.58
2007	7.99	11.09
Total	46.55	50.33
Increase / decrease	8% reduction	

Table 6.1 Linear Regression Line and Observed Results

6.2.2 Fatal Crashes

Figure 6.3 shows the fatal crashes recorded for 50km/h streets in Toowoomba from 1998 to 2007. There were only 5 fatal crashes that occurred in 50km/h zones in the 10 years of crash data used and all 5 crashes occurred after the 50km/h speed limit was introduced. It is safe to assume that a lower speed limit did not in fact cause fatal crashes to occur. Further investigation into these fatal crashes revealed that of the 5 crashes, 2 were due to driving under the influence of drugs or alcohol, 2 more due to excessive speeding and the remaining one due to inattention and driving through a stop sign.

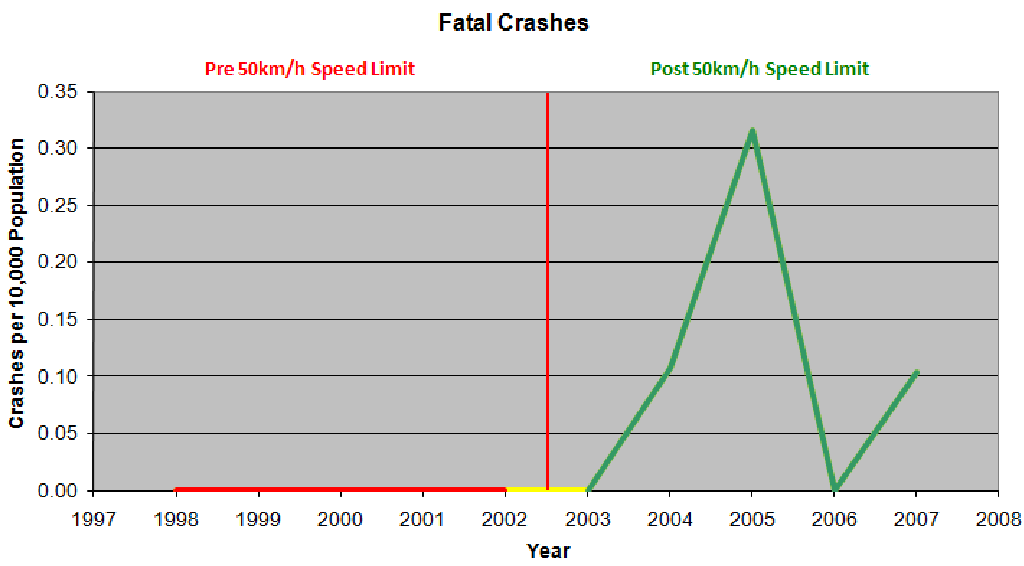

Figure 6.3 Fatal Crashes in Toowoomba

6.2.3 Hospitalisation Crashes

Figure 6.4 depicts the amount of crashes occurring on 50km/h streets in Toowoomba from 1998 to 2007, where the most severe injury resulted in a person involved being admitted to hospital. There is sufficient data on hospitalisation crashes for a regression line to be established and extrapolated giving estimated data for 2003 to 2007 if the 50km/h speed limit had not been implicated. As it can be seen in figure 6.5, the regression line actually decreases as it is projected into post treatment years, resulting in a 17% increase in hospitalisation crashes. If the regression line is not used and pre treatment data is compared to post treatment data, an increase of only 10% is observed. The result attained using the linear regression line will be used in the results as to not show bias. When comparing the trend for hospitalisation crashes to that of total crashes, it appears to be steadily decreasing from 2004 to 2007, whereas total crashes appeared to be increasing, yet a decrease in crashes actually occurred.

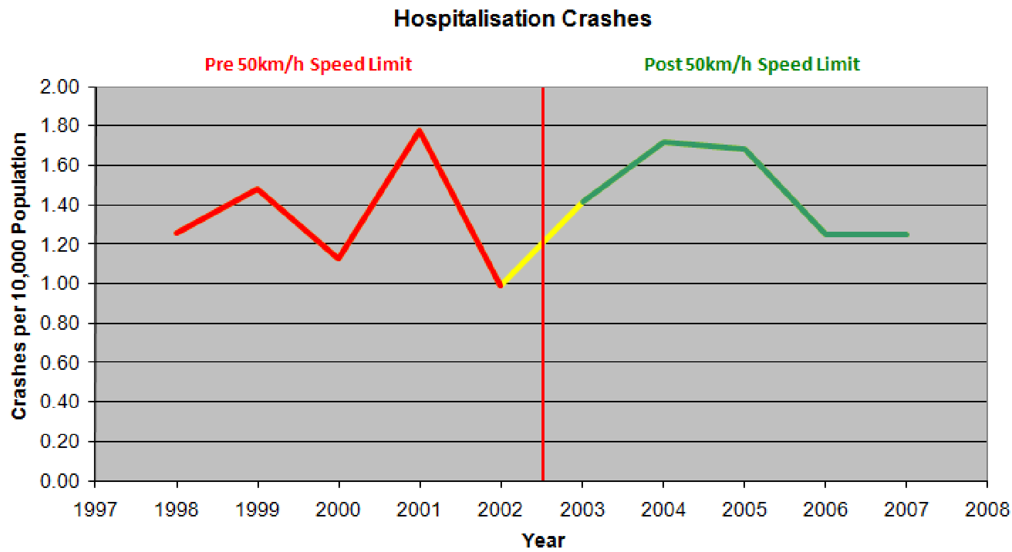

Figure 6.4 Hospitalisation Crashes in Toowoomba

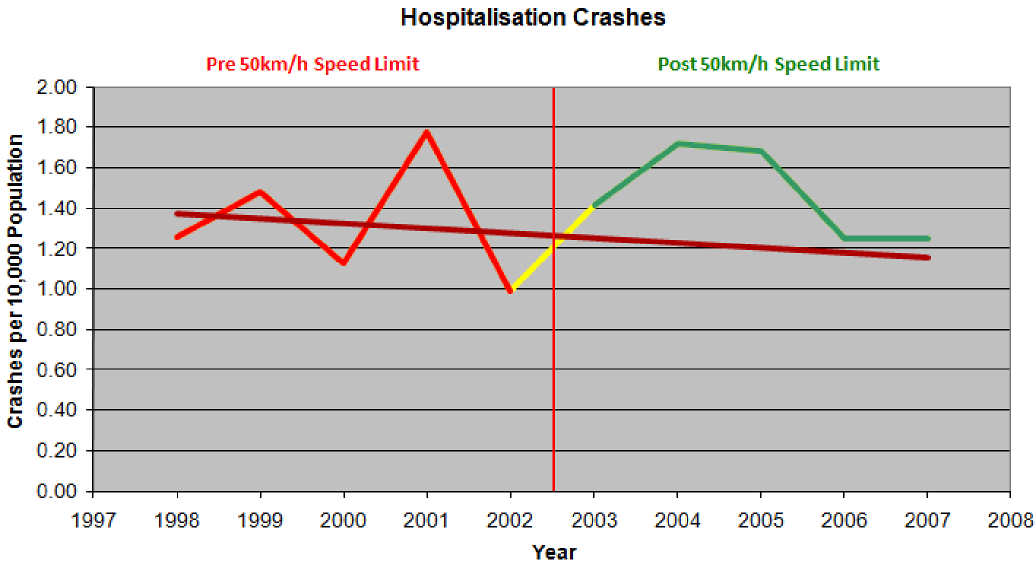

Figure 6.5 Hospitalisation Crashes Linear Regression Line

6.2.4 Medical Treatment Crashes

Figure 6.6 shows the amount of crashes for each year from 1998 to 2007 where the most severe injury attributed to the crash required medical treatment, resulting in someone going to hospital for observation or treatment but not being admitted or visiting a General Practitioner (GP). The observed trend is similar to that of total crashes with a slight decrease in 2003, increase in 2004 and 2005, a significant decrease in 2006 and then a differentiation from total crashes with a further decrease in 2007. As there is sufficient data, a linear regression line was fitted to the 1998 to 2002 data, and extrapolated as seen in figure 6.7, giving a decrease of 30% in medical treatment crashes for the 2003 to 2007 period.

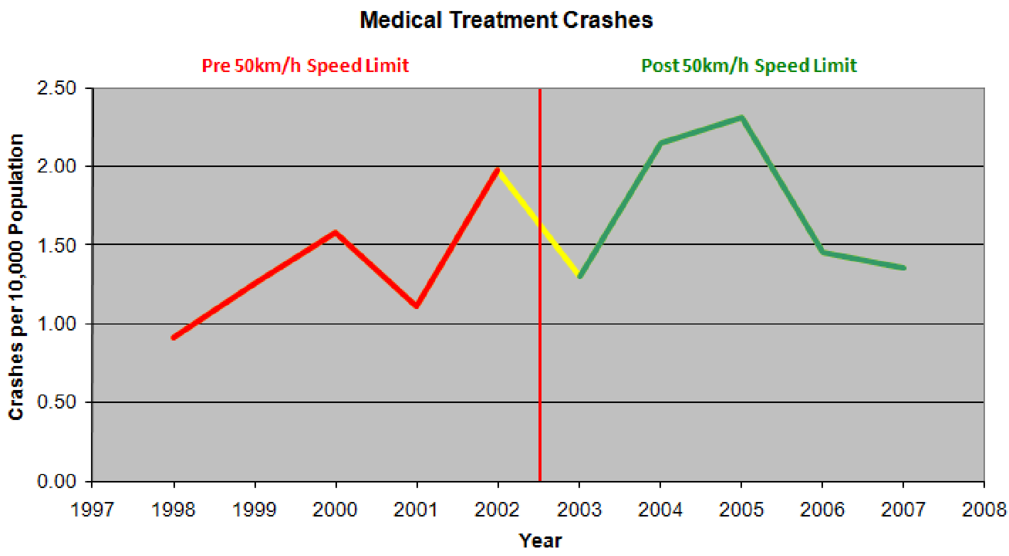

Figure 6.6 Medical Treatment Crashes in Toowoomba

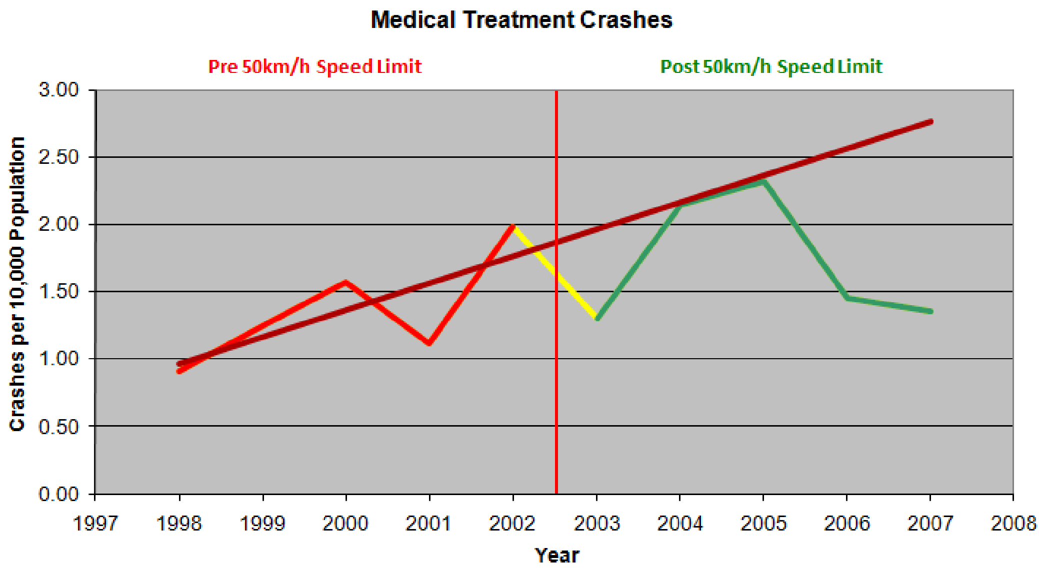

Figure 6.7 Medical Treatment Crashes Linear Regression Line

6.2.5 Minor Injury Crashes

Figure 6.8 displays the amount of crashes where the most seriously injured person had only minor injuries. The data appears to fluctuate a significant amount with underlying trends. The pre implementation trend appears to be increasing, whereas the post implementation trend appears to be remaining steady with a continued rise in 2007. A linear regression line was fitted to pre implementation data and extrapolated to 2007 as seen in figure 6.9. Comparing these values yields a decrease of 39% in minor injury crashes.

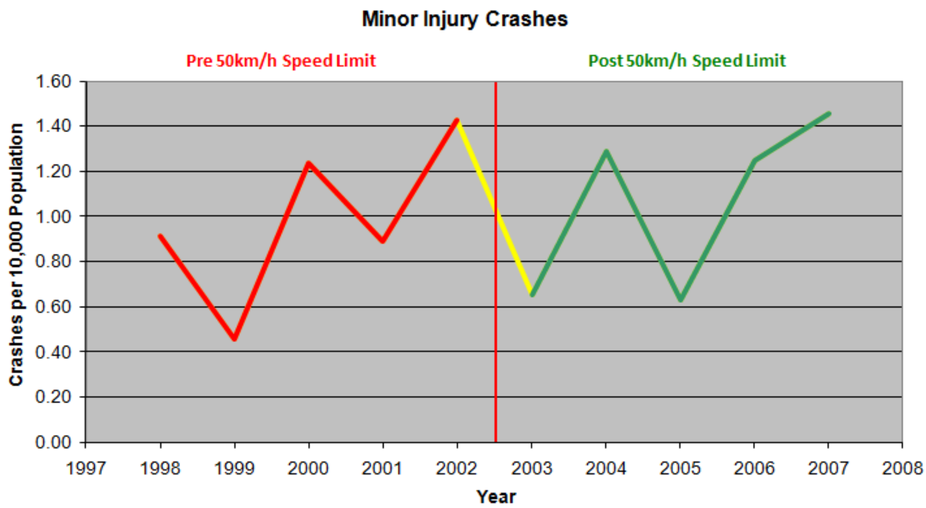

Figure 6.8 Minor Injury Crashes in Toowoomba

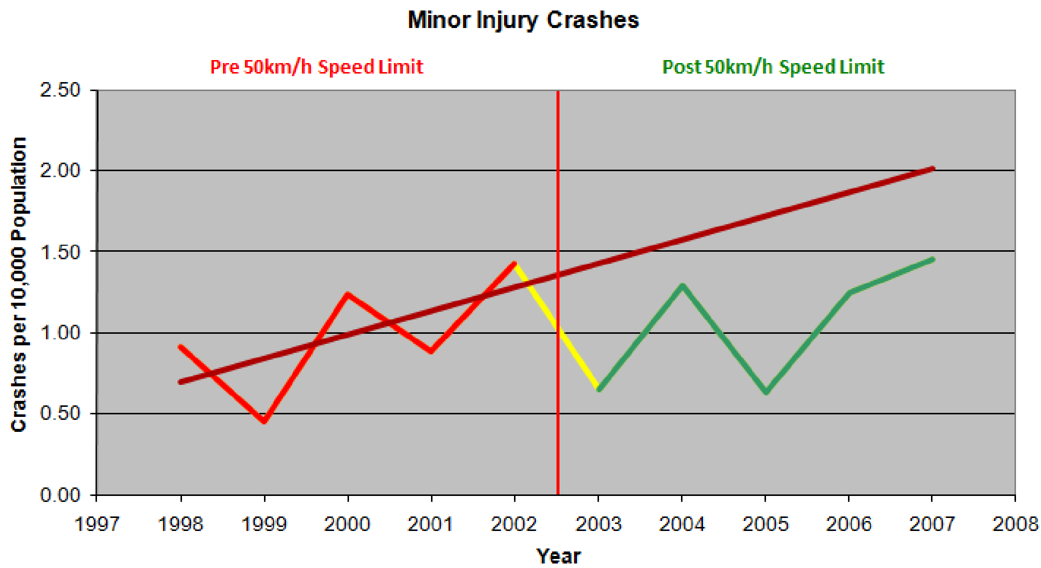

Figure 6.9 Minor Injury Crashes Linear Regression Line

6.2.6 Casualty Crashes

Figure 6.10 shows the amount of casualty crashes for each year from 1998 to 2007 which occurred on roads with a speed limit of 50km/h in Toowoomba. The data from 1998 to 2002 follows an increasing trend and a linear regression line was fitted. When comparing the observed results to the those generated by the linear regression line in figure 6.11, a significant deviation showing a decrease was observed in 2003, with results for 2004 and 2005 returning to fitting with the linear regression line. The observed data for 2006 and 2007 decreases significantly away from the linear regression line, resulting in a decrease in casualty crashes. The comparison between observed and predicted results produces a reduction of 17% in fatal crashes.

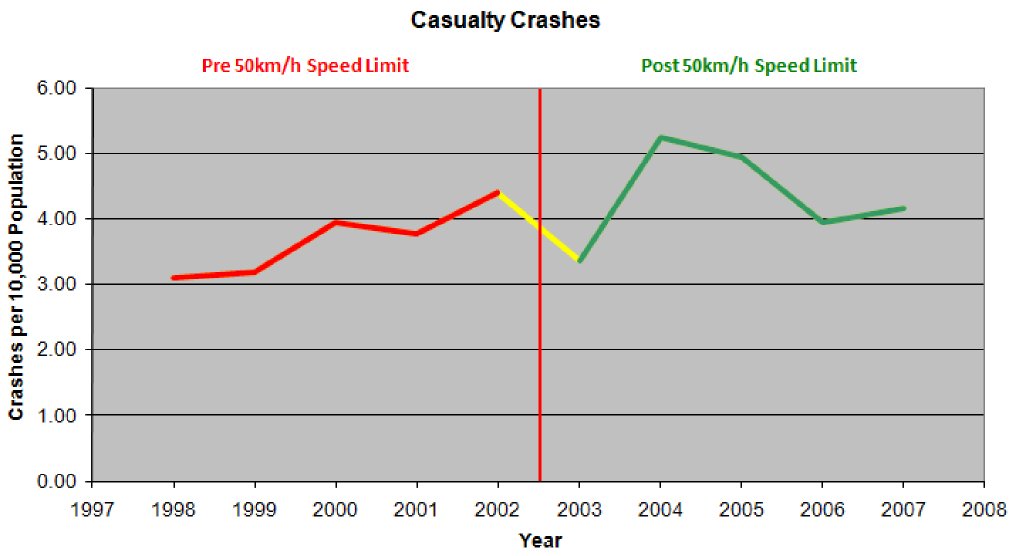

Figure 6.10 Casualty Crashes in Toowoomba

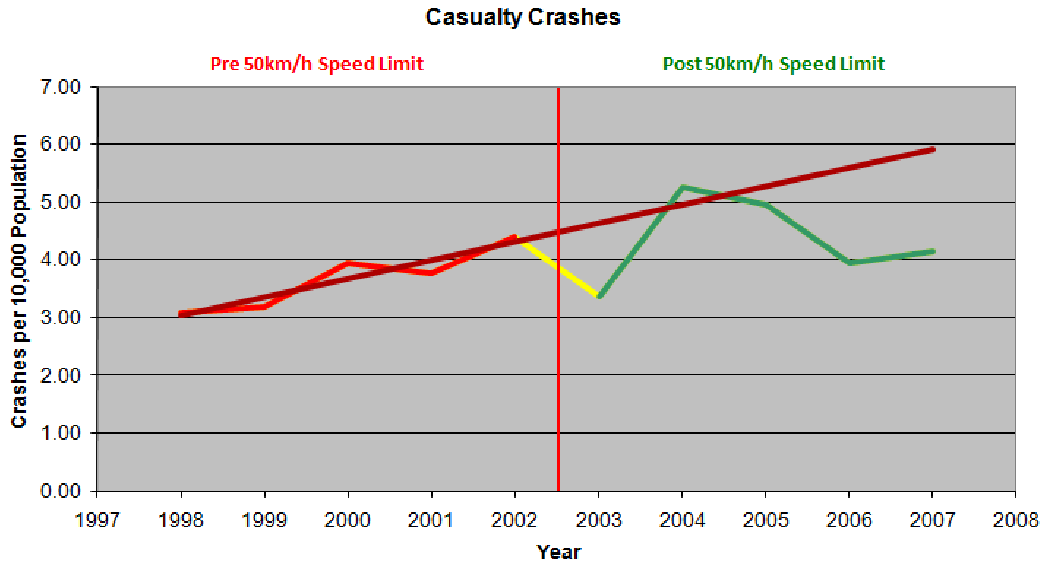

Figure 6.11 Casualty Crashes Linear Regression Line

6.2.7 Property Damage Crashes

Figure 6.12 shows the amount of crashes occurring on roads with a 50km/h speed limit from 1998 to 2003, where no one was injured but property damage with a value of $2,500 or greater was caused or at least one vehicle was required to be towed away. Fitting a linear regression line to the 1998 to 2002 data produces a slightly increasing linear regression line as seen in figure 6.13. There was also an increase in 2003 however if a linear regression line is fitted to the data from 2003 to 2007, there is actually a decreasing trend. Due to the increasing trend in the data from 2003 to 2005, an increase of 3% was observed for property damage crashes.

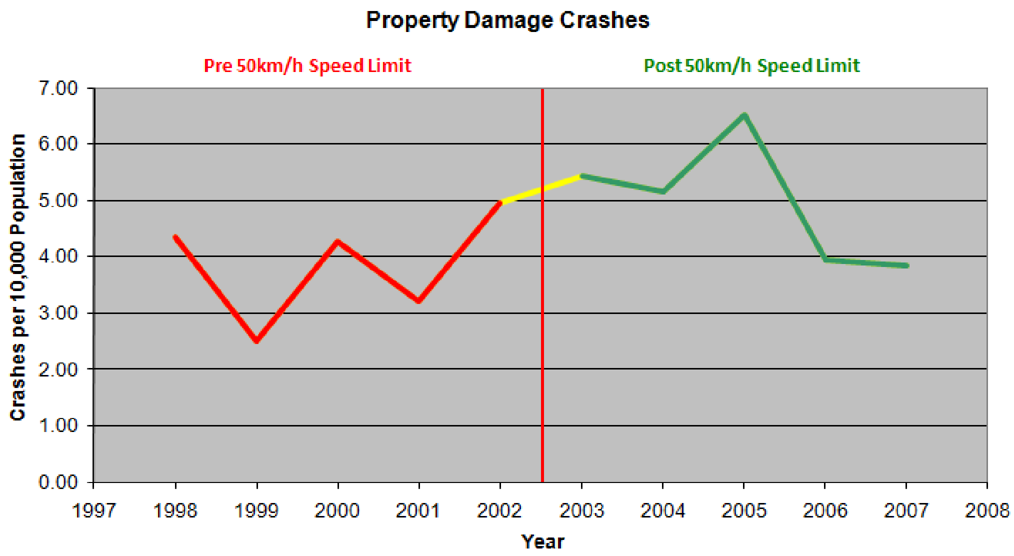

Figure 6.12 Property Damage Crashes in Toowoomba

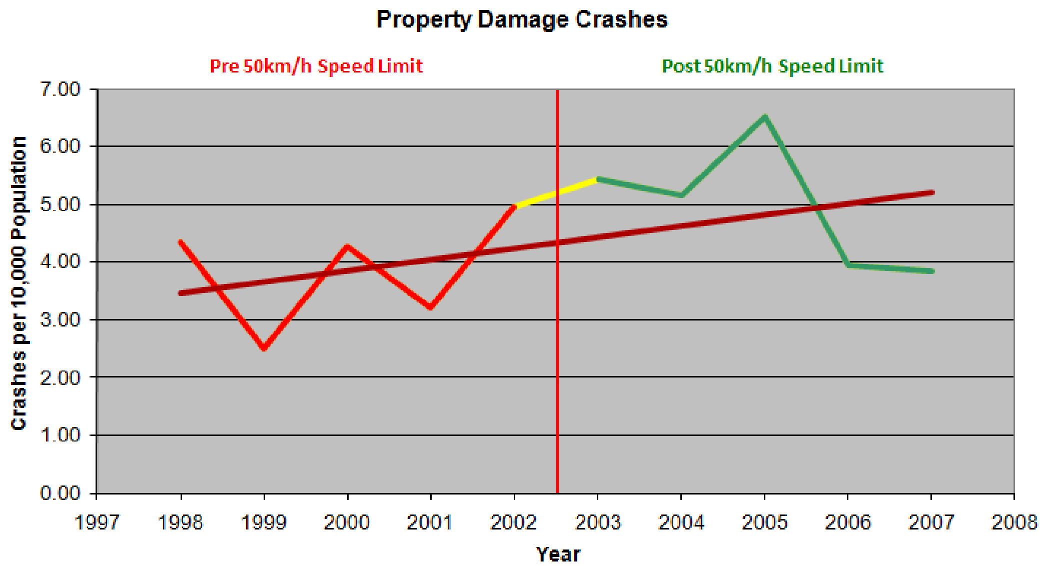

Figure 6.13 Property Damage Crashes Linear Regression Line

6.3 Crashes Involving Pedestrians

Tables showing all calculated values regarding pedestrian crashes can be seen in Appendix J & K, and the results will be discussed in detail in this section of the report.

6.3.1 Total Pedestrian Crashes

Figure 6.14 shows the total amount of crashes involving pedestrians from 1998 to 2003 on streets with a speed limit of 50km/h in Toowoomba. The data from 1998 to 2001 depicts a rapid increase in the amount of crashes though there is a significant decrease in pedestrian crashes in 2002. This decrease could be attributed to the mass media scare campaign used by the Queensland Government leading up to the 50km/h depicting the effects that travelling at 60km/h rather than 50km/h has on impact and avoiding hitting pedestrians. When a linear regression line was fitted to the data from 1998 to 2002 and projected to 2007 (as seen in figure 6.15) a decrease of 28% in total crashes involving pedestrians was achieved.

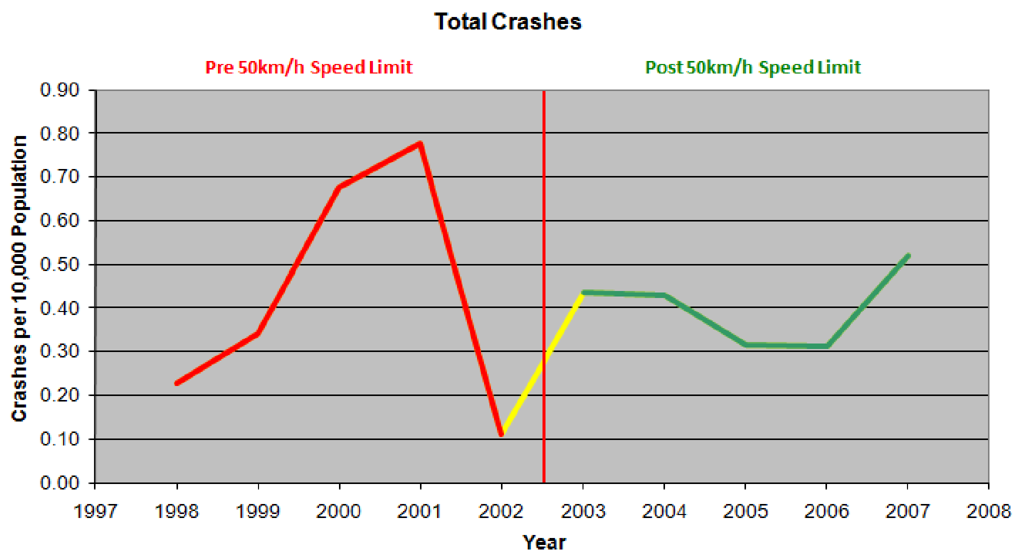

Figure 6.14 Total Crashes Involving Pedestrians in Toowoomba

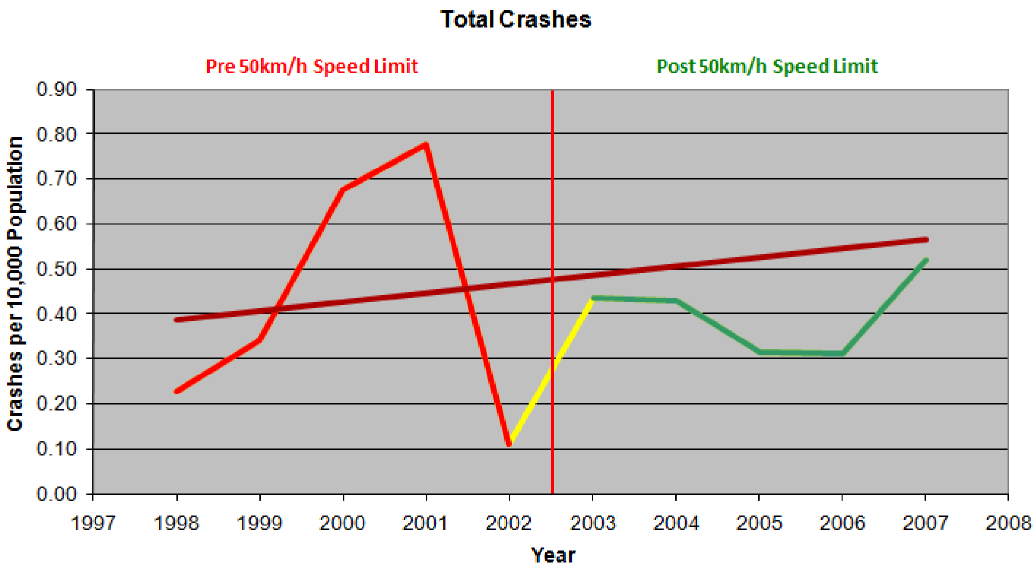

Figure 6.15 Total Crashes Involving Pedestrians Linear Regression Line

6.3.2 Fatal Crashes Involving Pedestrians

Figure 6.16 shows the two crashes that occurred on streets with a 50km/h speed limit in Toowoomba that involved pedestrians; with both crashes occurring after the 50km/h speed limit was introduced. Of the two crashes, one was a result of excessive speed and the other due to driving under the influence. This data will be excluded from the comparison as there is insufficient data to make a valid evaluation.

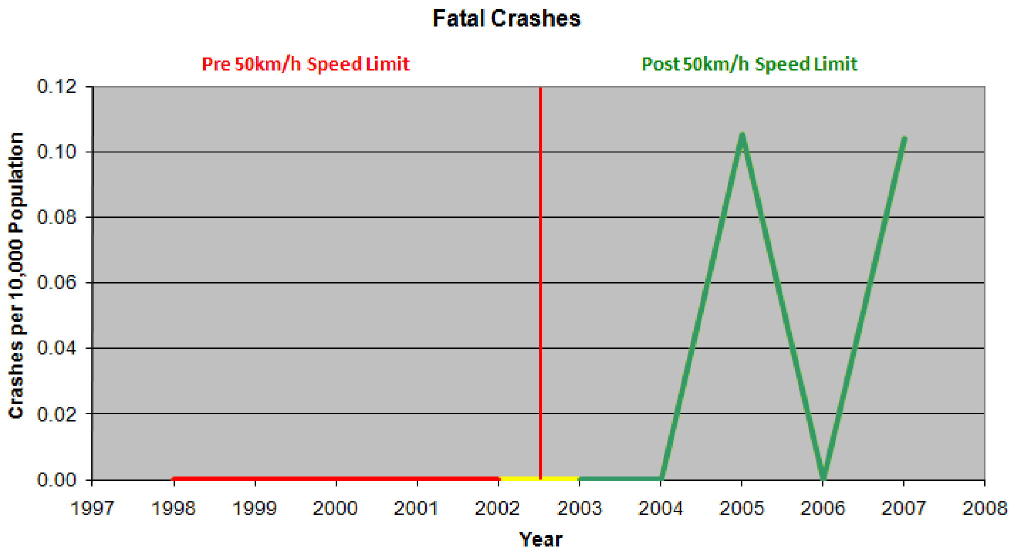

Figure 6.16 Fatal Crashes Involving Pedestrians in Toowoomba

6.3.3 Hospitalisation Crashes Involving Pedestrians

The amount of hospitalisation crashes from 1998 to 2007 for streets with a speed limit of 50km/h for Toowoomba can be seen in figure 6.17. As 51% of all crashes involving pedestrians are hospitalisation crashes, the trend observed is very similar to that observed for total crashes involving pedestrians. When fitting a linear regression line to the pre 50km/h speed limit and extending it to 2007 as displayed in figure 6.18, a reduction of 72% in hospitalisation crases is achieved. The significant decrease in crashes in 2002 is believed to be a result of the mass media scare campaign implemented by the Queensland Government prior to the 50km/h speed limit beginning.

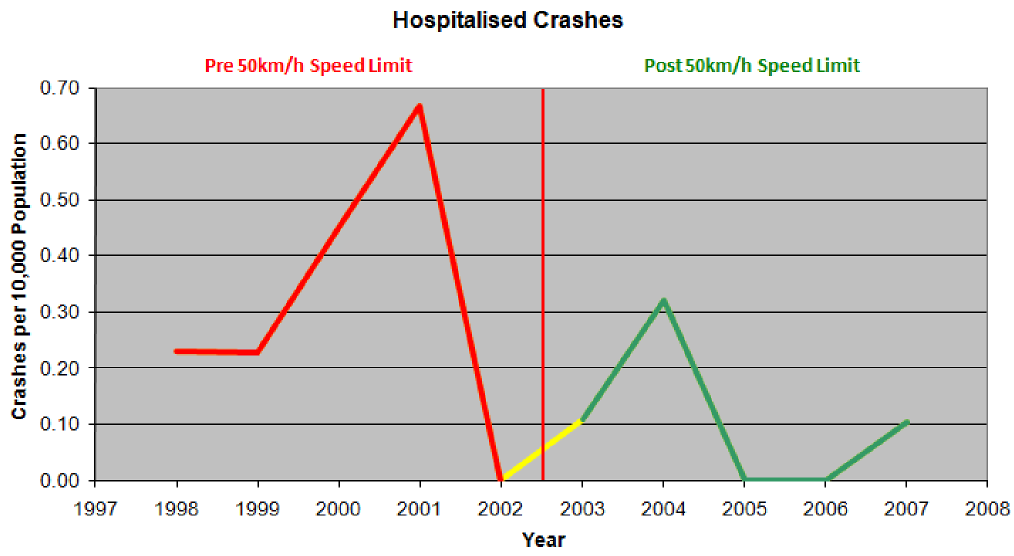

Figure 6.17 Hospitalised Crashes Involving Pedestrians in Toowoomba

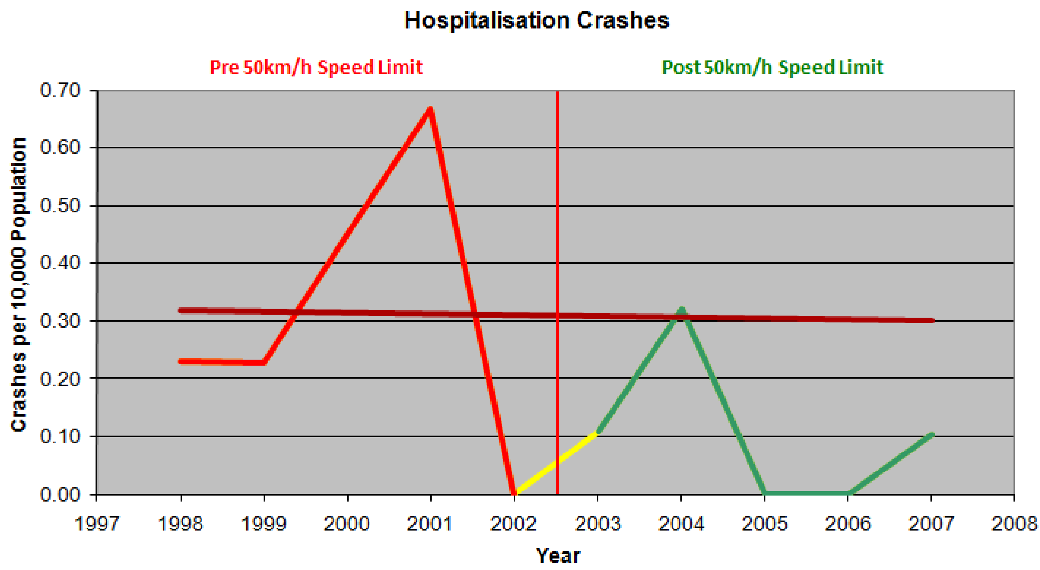

Figure 6.18 Hospitalised Crashes Involving Pedestrians Linear Regression Line

6.3.4 Medical Treatment Crashes Involving Pedestrians

Figure 6.19 shows the amount of crashes involving pedestrians on 50km/h streets in Toowoomba from 1998 to 2007, where the most seriously injured person involved in the crash required medical treatment, such as being briefly admitted to hospital or requiring a visit to a GP. The increase in medical treatment crashes is believed to be the result of the significant decrease in hospitalisation crashes. As some of the hospitalisation crashes that would have occurred, may have been avoided altogether while others only reduced in severity. This idea will be discussed further in section 6.8. When a linear regression line is matched to the data from 1998 to 2002 and extrapolated as seen in figure 6.20, an increase of 115% in medical treatment crashes is observed.

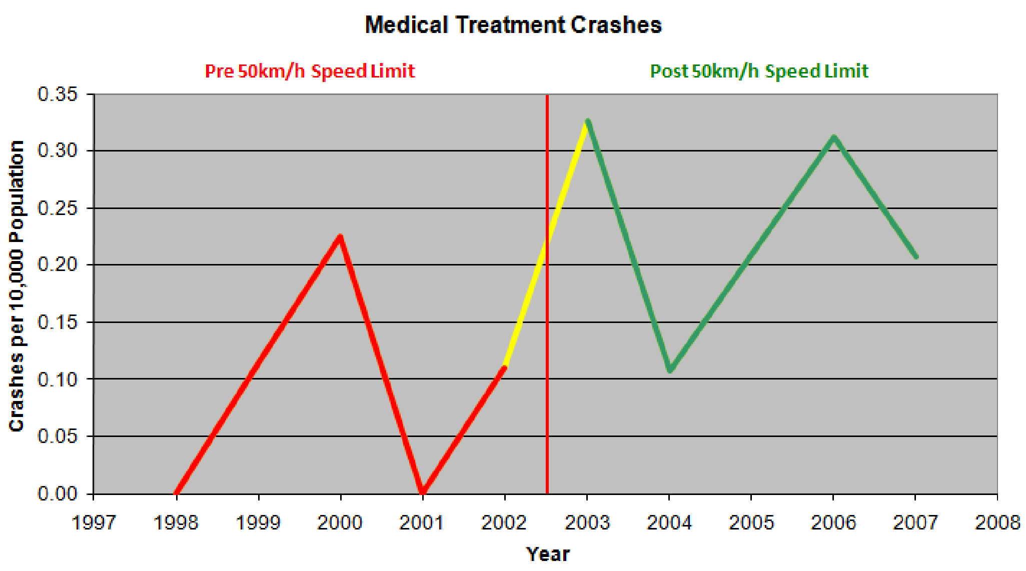

Figure 6.19 Medical Treatment Crashes Involving Pedestrians

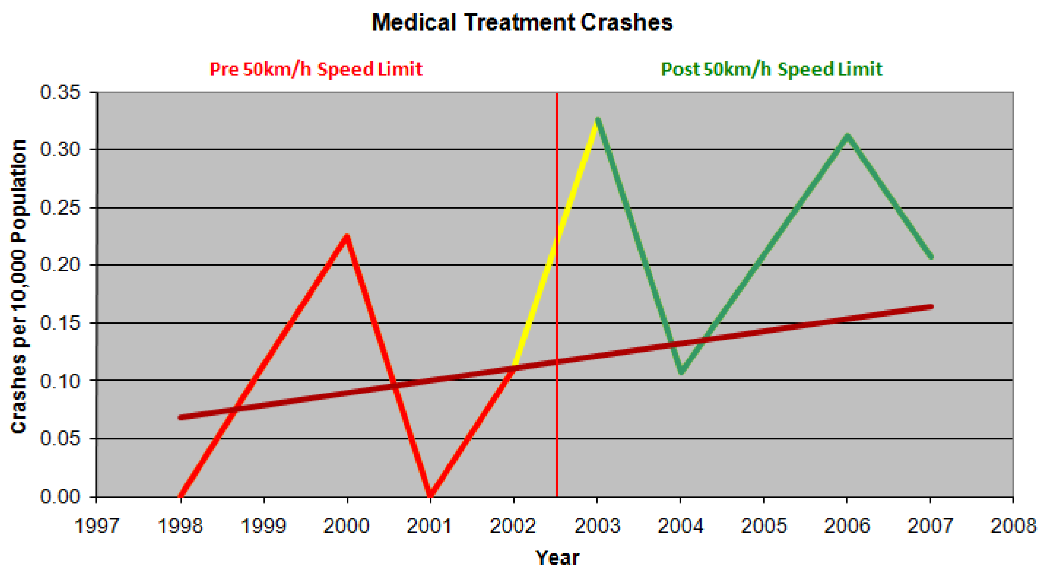

Figure 6.20 Medical Treatment Crashes Involving Pedestrians Linear Regression Line

6.3.5 Minor Injury Crashes Involving Pedestrians

Figure 6.21 depicts the amount of minor injuries on 50km/h streets in Toowoomba from 1998 to 2007. As can be seen, there are only 2 minor injury crashes in the 10 years of data. This is believed to be due to the nature of the crashes involving pedestrians. For example, the crashes may have been avoided and therefore not recorded, or the person impacted sustained injuries warranting at least medical treatment. Very few crashes involving pedestrians only come off with minor injuries, and the majority of the few that do occur are most likely just dealt with at the scene and not reported to police.

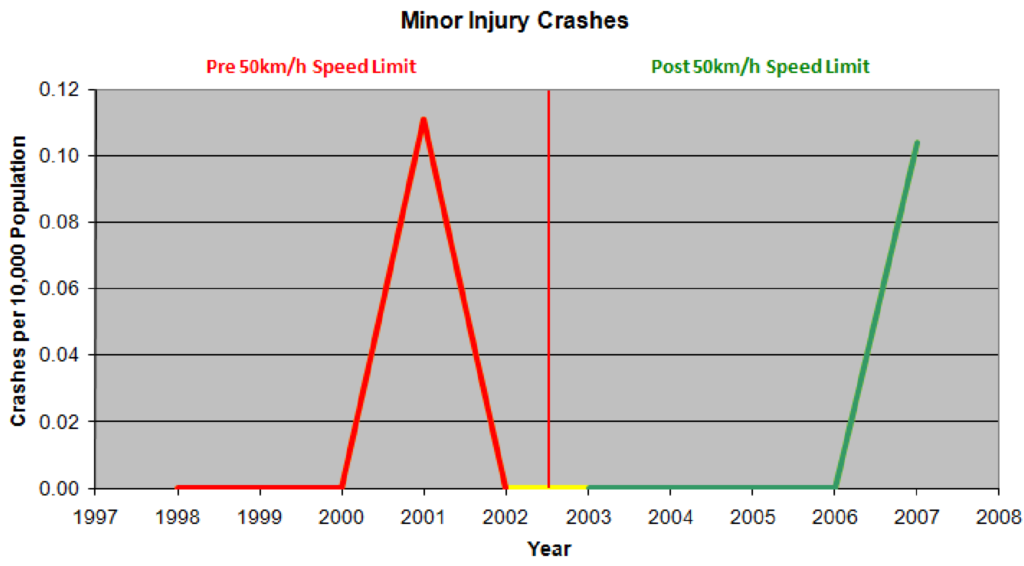

Figure 6.21 Minor Injury Crashes Involving Pedestrians in Toowoomba

6.4 Results Summary

Table 6.2 shows the reduction and increase in percentages for the different crash groupings and severity levels calculated, in comparison with the other 50km/h speed limit evaluations completed for the different states and territories of Australia.

	Location	Toowoomba	South-East QLD	Regional QLD	NSW	Victoria	WA	SA	Tasmania	ACT	NT
All Crashes	Total	8%	22%	13%	23%	N/A	20%	N/A	No evaluation done	9%	Still has a speed limit of 60km/h
	Fatal	N/A	88%	19%	N/A	53%	N/A	40%		N/A	
	Casualty	17%	23%	N/A	19%	13%		23%		32%	
	Hospitalisation	-17%	N/A		N/A	N/A		N/A		N/A	
	Medically Treated	30%									
	Minor Injuries	39%									
	Property Damage	-3%									
Pedestrian Crashes	Total	28%			20%	20%	51%	21%			
	Fatal	N/A			N/A	N/A	N/A	N/A			
	Hospitalisation	72%									
	Medically Treated	-115%									
	Minor Injuries	N/A									

NA	Not enough data to make a valid increase or decrease evaluation
-1%	Percentage Increase in crashes
1%	Percentage Decrease in crashes

Table 6.2 Results Summary of all 50km/h Speed Limit Evaluations

6.5 Economic Analysis

People generally value their own lives very highly, and often the same can be said for the lives of family and close friends. Indeed, life can be argued to be priceless, as without life money would be of no use. At the other end of the spectrum however, much lower implicit values are placed on lives every day. Each time a decision is made regarding the allocation of funding to health and emergency services, to workplace occupational health and safety projects, and indeed to any activity which aims to save lives or prevent injuries, life has an assumed implicit monetary value (Bureau of Transport Economics 2000).

A study was done by the Bureau of Transport Economics, to determine the monetary values associated with the different crash severities. These value estimates were determined by associating the different costs involved in a crash such as, Medical/Ambulance/Rehabilitation, loss of labour in the workforce, labour at home, quality of life, legal costs, correctional services, workplace disruption, vehicle repairs, travel delays, insurance, police and fire to name a few (Bureau of Transport Economics 2000). These values were used to calculate the average cost per crash at the different severity levels, these values can be seen in table 6.3.

Crash Severity	Cost per Crash
Fatal	$ 1,652,994
Serious	$ 407,990
Minor	$ 13,776
Property Damage Only	$ 5,808

Table 6.3 Average Cost per Crash for Different Severities

The prices listed in table 6.3 are given in monetary values for 1996, and were scaled up using the Consumer Price Index (CPI) associated with its corresponding year. For example, a fatal crash occurring in 1996 would cost $1,652,994 and $2,043,404 in 2007, that's an increase of $390,410 or 19%. The cost of crashes for each year was calculated by scaling the average cost per crash by the CPI for the year, then the crashes were scaled with the population of Toowoomba for the year as they had all be scaled down to crashes per 10,000 people. The two values were multiplied, to give the cost per severity level for the year. This was repeated for each severity level, for the observed and projected linear regression line data for 2003 to 2007.

Comparing the crash costs associated with the projected linear regression line data for the different severity levels, with that of the observed crashes, there was a saving of $2,989,729 over the 5 year period from 2003 to 2007 as displayed in table 6.4. This equates to an average saving of $600,000 a year. To put it into perspective, the cost of implementing the 50km/h default urban speed limit in the ACT was $485,000. Of that total, $395,000 was for signage alone so for Toowoomba it would be less but there are no figures available Toowoomba or QLD. Even if the cost for implementing the 50km/h speed limit in Toowoomba was the same as in the ACT, it would have payed itself off within the first year of being implemented. Doing a Benefit-Cost Ratio (BCR) for Toowoomba using the cost for ACT as a guide as it would be overestimating the cost, a BCR of 7.6 is achieved for the 5 year period. The ACT achieved a saving of $3,974,000 and a BCR of 8.2 when comparing 3 years of data before the 50km/h speed limit was introduced to 3 years after. For all values associated with the costs related to the different crash severities refer to appendix L.

Crash Severity	Before (projected)	After (observed)	Saving
Fatal	$0	$9,900,589	-$9,900,589
Serious	$85,205,216	$72,807,898	$12,397,318
Minor	$1,350,985	$825,332	$525,653
Property Damage	$1,588,203	$1,620,856	-$32,653
		Total	$2,989,729

Table 6.4 Cost of Crashes from 2003 to 2007

Some evaluations mention quantities values in the form of savings associated with the reduction in fuel consumption due to travelling at a lower speed, and extra costs associated with the increased travel time due to vehicles travelling at a lower speed. These values were not included because they were considered to be minimal, if at all significant, with fuel consumption estimated to be around 4.2% (Green, Gunatillake & Styles 2003) while travelling at 50km/h (this of course varies with the vehicle) and with local streets being designed to move local traffic to 60km/h roads quickly. The extra travel time associated with the lower speed limit is considered to have no noticeable effect, with the majority of travel time on local roads being made up of waiting at intersections. Australia Post has also commented that the 50km/h default urban speed limit has had no noticeable effect on their travel and delivery times (National Road Transport Commission, 2003).

The greatest cost associated with the implementation of the 50km/h speed limit was the $9.9 million relating to the 5 fatal crashes occurring after the 50km/h speed limit was introduced, compared to none occurring before. Investigations were undertaken into these 5 fatal crashes looking at ways to decrease them and further improve the effectiveness of the 50km/h default urban speed limit. Upon further investigation into these crashes, it was identified that all 5 crashes were due to a crash type of the “Fatal 4”. Two of the crashes were due to excessive speeding, 2 a result of Driving Under the Influence of drugs or alcohol (DUI) and 1 due to inattention. To help further reduce the amount of fatal crashes on Toowoomba roads, possibly some of the $2.9 million dollars saved from the 50km/h default urban speed limit safety initiative could be reinvested into public education campaigns to combat the amount of crashes resulting from the fatal 4, as the fatal 4 caused $2.82 million in damages a year on average on 50km/h streets in Toowoomba. Table 6.5 shows the average amount of crashes each year from 2003 to 2007 that have occurred on 50km/h streets in Toowoomba, and their associated costs.

Average Crashes per year due to the fatal 4 on 50 km/h streets in toowoomba

Factors	Fatal	Serious Injury	Minor Injury	Combined Cost Per Year
Speeding	0.4	2.8	5.4	$ 1,012,400.00
Driving under the influence	0.4	1.6	2.6	$ 913,600.00
Inattention	0.2	6.8	11.6	$ 891,600.00
Fatigue	0	0	0.4	$ 6,400.00

Table 6.5 Average Crashes per Year from the "Fatal 4"

6.6 Frequent Crash Sites

Using the crash data from the analysis, sites where the most crashes occurred were identified for each severity level as well as total crashes on 50km/h streets in Toowoomba. The sites identified were Geddes St, McGregor St, Neil St, Vanity St and the intersections of Buckland & Yaldwyn St, Erin & Fitzpatrick St and Mort & Taylor St. A map that identifies these streets and intersections can be seen in figure 6.22. All street view pictures and aerial photos were generated using Google Maps and Google Maps, Street View. The crashes at each site will be described according to the DCA codes recorded for the crashes that occurred. For pictorial descriptions of the DCA codes refer to figure 2.6.

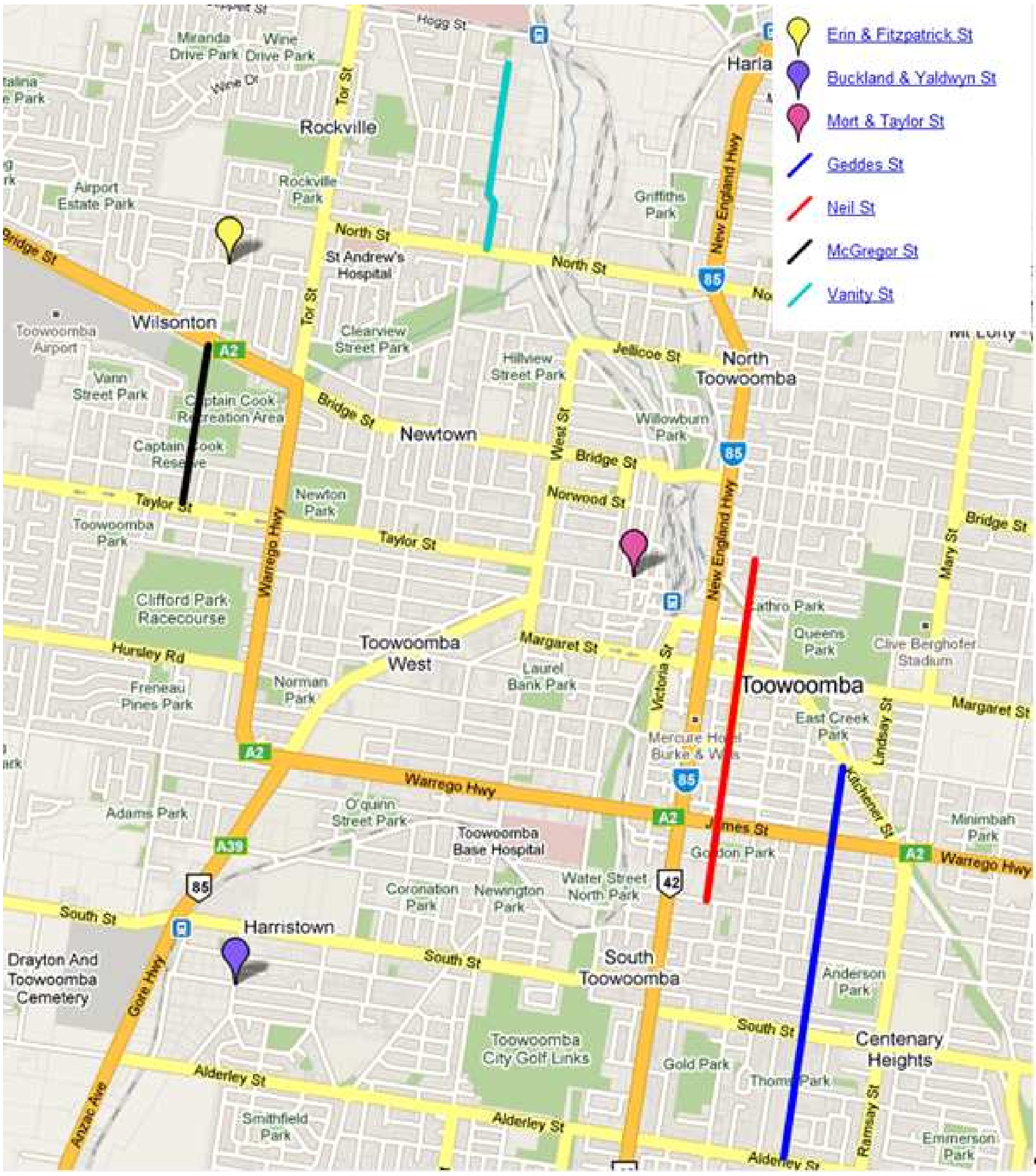

Figure 6.22 Identified Frequent Crash Sites

6.6.1 Geddes Street

Geddes Street as seen in figures 6.23 and 6.24 was identified as being the street with the most hospitalisation crashes occurring after the 50km/h speed limit was introduced. Over the study period, Geddes Street had 8 crashes, 1 in both 1999 and 2002, and 2 in 2003, 2004 and 2005. Of the 8 crashes there were 3 hospitalisation crashes, 2 medically treated crashes and 3 property damage only crashes. Using the DCA codes, the types of crashes occurring along the street can be identified.

Table 6.6 lists the DCA codes for the crashes in Geddes St and the amount of crashes attributed to each. DCA codes 301 and 303 refer to being hit from behind from a vehicle in the same lane. As can be seen in figure 6.23, a section of Geddes St is comprised of two lanes separated by a traffic island with a nature strip which contains trees. If the vehicle in front suddenly stopped, the vehicle behind's only option is to brake. Trying to divert to either the left or right would result in mounting the kerb at speed and possibly hitting a tree. Mounting the kerb at even 50km/h would still do a significant amount of damage to the vehicle and possibly the occupants.

DCA codes 703 and 704 refer to a vehicle travelling along a straight road and then detouring either left or right and impacting an object. Geddes St is lined with trees for both the divided and single roadway sections, and any detour from the road is likely to result in impacting an object such as a tree. This could be result of trying to avoid a vehicle or person suddenly coming onto the road ahead, the vehicle in front suddenly braking, or the driver losing control and crashing into a tree. DCA code 700 refers to a vehicle travelling along a straight road and then going off the path and crashing. It is coded as other so the result is unknown, the police report will have the actual result and it may just be a case of the result not fitting into the standard descriptions.

DCA Codes	Number of Crashes Per Code
301	1
303	1
700	2
703	3
704	1

Table 6.6 DCA Codes for Geddes St Crashes

Figure 6.23 Geddes St, Alderley St to South St

Figure 6.24 Geddes St, South St to Kitchener St

6.6.2 McGregor Street

McGregor Street had the 2nd highest amount of crashes on a single street in Toowoomba over the study period, having 9 crashes varying in severity with 2 hospitalisations, 1 minor injury and 6 property damage only crashes. McGregor Street is classified as a local street by Toowoomba Regional Council, but has 50km/h speed signs along it, possibly as a result of having an increased amount of crashes compared to other local streets. The council is trying to raise public awareness in which case other speed management devices may need to be considered.

As it can be seen in figure 6.25, McGregor St is a reasonably long and straight street, with sporting grounds adjacent to it as seen in figure 6.26. On Saturday mornings when sports are scheduled it is a considerably busy street with cars coming and going constantly. It is actually surprising that there are not more crashes for McGregor St, having driven along its length on a Saturday morning.

The different DCA codes and amounts can be seen in table 6.7. DCA codes 301, 302 and 303 refer to crashes where a vehicle runs into another from behind while going straight, turning left or turning right. These could be caused by vehicles seeing a vacant car park and suddenly braking to turn into them or trying to avoid children running onto the road. It could be assumed that the volume and unpredictability of children on and around the road during the peak sports season may contribute to these three types of crashes. DCA code 703 refers to vehicles travelling along a straight path and then going off the path to the left and impacting an object.

DCA Codes	Number of Crashes Per Code
301	3
302	1
303	1
703	4

Table 6.7 DCA Codes for McGregor St Crashes

Figure 6.25 McGregor Street, Street View

Figure 6.26 Sporting Grounds Adjacent to McGregor Street

6.6.3 Neil Street

Neil St, which can be seen in figure 6.27 was identified as having the most medically treated, property damage and total crashes from 2003 to 2007, having 2 medically treated, 6 property damage a total of 12 crash. Over the entire study period there were 2 hospitalisation crashes, 4 medically treated crashes, 3 minor crashes and 8 property damage crashes along Neil St.

As Neil St passes through Toowoomba's Central Business District (CBD), a small section from Russell to Herries St becomes a 3 lane, one way sub-arterial road as seen in figure 6.28. For this section of the road, 50km/h speed signs have been erected. Using the DCA codes for the crashes along Neil St displayed in table 6.8, it can be seen that there are 3 codes that do not occur at the other investigated crash sites, these are 305, 306 and 308.

The 3 DCA codes of 305, 306 and 308 refer to vehicles travelling in the same direction sideswiping, lane changing and sideswiping while turning. These vehicle manoeuvres are for multi-lane, single direction carriageways and therefore would not occur on local streets and were consequently removed from the dataset for this report as it is focusing on crashes occurring on local streets. Excluding these 9 crashes, it brings the amount of crashes occurring on Neil St more in line with other local streets.

DCA Codes	Number of Crashes Per Code
001	1
003	1
305	1
306	3
308	5
400	1
406	2
703	1
704	2

Table 6.8 DCA Codes for Neil Street Crashes

Figure 6.27 Neil Street, Street View

Figure 6.28 Neil Street, Russell Street to Herries Street

6.6.4 Vanity Street

Vanity St was identified as the street where the most hospitalisation crashes occurred before the 50 km/h speed limit was implemented. After the implementation of the 50km/h speed limit, Vanity St had no reported crashes so the 50km/h speed limit had a positive impact on Vanity St. Prior to the 50km/h speed limit there were 6 crashes on Vanity St, 3 hospitalisation crashes and 3 medically treated crashes. The DCA codes for these crashes can be seen in table 6.9. DCA code 000 refers to a crash involving a pedestrian with no other specific information given. DCA code 202 refers to a crash occurring where one vehicle hits a turning vehicle at a 90 degree angle. Code 301 has been mentioned earlier as to describe an accident where one vehicle rear ends another, 406 involves a vehicle leaving a driveway and 802 is a vehicle travelling on a left bend going off the road into an object.

During the site inspection of Vanity St, the main road hazard is depicted in figures 6.29 and 6.30. There is an S-bend going up a hill with a T-intersection at the bottom of the S-bend, with what appears to be entry to 2 factories or workshops along the S-bend. There is virtually no sight distance for vehicles in the bend so vehicles pulling out of the workshops or T-intersection at the bottom of the hill would have to rapidly accelerate onto the road when they believe there are no vehicles approaching. Travelling through this S-bend while it was a 60 km/h zone would have been very dangerous. Most of the Vanity St crashes if not all could be attributed to this one S-bend, as all the crash descriptions fit those that would be associated with a S-bend such as this, excluding the pedestrian crash where no information is given except that a pedestrian was involved.

DCA Codes	Number of Crashes Per Code
000	1
202	2
301	1
406	1
802	1

Table 6.9 DCA Codes for Vanity Street Crashes

Figure 6.29 Vanity Street, Hill Approach from Bottom

Figure 6.30 Vanity Street, Hill Approach from Top

6.6.5 Intersection of Buckland and Yaldwyn Street

The Buckland and Yaldwyn St intersection seen in figures 6.31 and 6.32 was identified as the site where the largest amount of medically treated crashes occurred before the 50km/h speed limit was introduced, with 4 crashes occurring before the 50km/h speed limit was introduced. Of these 4 crashes, 3 were medically treated crashes and 1 was a hospitalisation crash. Only 1 crash occurred at the intersection after the 50km/h speed limit was introduced and it was a medically treated crash. This shows that the 50km/h urban speed limit had a positive impact on this intersection, reducing the amount of crashes occurring there over a 5 year period by 75%.

When looking at the DCA coding for the Buckland and Yaldwyn St intersection seen in table 6.10, it can be seen that all crashes had a code of 101. This code refers to crashes at an intersection where vehicles from adjacent approaches collide. Further investigation of the crash causes given by Queensland Transport crash data identified that all the crashes were a result of a driver failing to give way or stop as required by the signs along Buckland St.

DCA Codes	Number of Crashes Per Code
101	5

Table 6.10 DCA Codes for Buckland and Yaldwyn Street Intersection Crashes

Figure 6.31 Buckland and Yaldwyn Street Intersection, Yaldwyn Street Approach

Figure 6.32 Buckland and Yaldwyn Street Intersection, Buckland Street Approach

6.6.6 Intersection of Erin and Fitzpatrick Street

The Erin and Fitzpatrick St intersection seen in figures 6.33 and 6.34 was identified as the site where the most minor, property damage and total amount of crashes occurred before the 50km/h speed limit was introduced. A total of 10 crashes occurred prior to the 50km/h speed limit was introduced. Of these 10, there was; 1 hospitalisation, 1 medically treated, 2 minor and 6 property damage crashes at the intersection. After the 50km/h speed limit as introduced there were only 3 crashes at the intersection including 1 minor, 1 property damage and 1 fatal crash. Excluding the fatal crash this is a noticeable reduction in number and severity of crashes at the intersection. The 1 fatal accident at the intersection was a result of a DUI and failing to give way.

While conducting the site inspection it was noted that there was a very limited sight distance at the intersection when travelling along Erin St from both approaches. Erin St is signed with give way signs at the intersection. While stopping to give way along Erin St during the site inspection, a vehicle travelling along Fitzpatrick St drove through the intersection travelling at what appeared to be an excessive speed. This cannot be confirmed however as no speed radar was used. The Wilsonton State School is located at the western end of Fitzpatrick St, and some traffic calming devices could be installed along Fitzpatrick St to deter through traffic and encourage traffic to follow the sub-arterial roads designed to carry the traffic to the school.

Looking at the DCA codes associated with the crashes at the intersection displayed in table 6.11, it is noted that the majority of the crashes at the intersection are classed as 101 which refers to crashes at an intersection where a vehicle from the adjacent street collides with the vehicle travelling through the intersection. All crashes were a result of a driver failing to give way as signed. DCA code 001 refers to a crash where a pedestrian is hit crossing the street from the nearside of the road. Code 103 refers to a vehicle turning left colliding with a vehicle travelling through the intersection, and 200 refers to vehicles travelling in opposite directions and colliding but not how they collided as it is listed as other.

DCA Codes	Number of Crashes Per Code
001	1
101	10
103	1
200	1

Table 6.11 DCA Codes for Erin and Fitzpatrick Street Intersection Crashes

Figure 6.33 Erin and Fitzpatrick Street Intersection, Erin Street Approach

Figure 6.34 Erin and Fitzpatrick Street Intersection, Fitzpatrick Street Approach

6.6.7 Intersection of Mort and Taylor Street

The Mort and Taylor St intersection seen in figures 6.35, 6.36 and 6.37 was identified as the site where the most property damage and total amount of crashes occurred after the 50km/h speed limit was introduced, as well as the most crashes that occurred over the entire study period. Over the study period there were 17 crashes at the Mort and Taylor St intersection, 9 of which occurred before the 50km/h speed limit was implemented. Of the 9 crashes there were 2 hospitalisation crashes, 2 medically treated crashes, 2 minor crashes and 3 property damage crashes. After the 50km/h speed limit was introduced there were only 8 crashes at the intersection; 2 were medically treated, 1 minor and 5 property damage only crashes.

This is a noticeable decrease in crash severity for the site, with a 100% decrease in hospitalisation crashes. Medically treated crashes stayed the same; perhaps because the crashes that originally required hospitalisation were now not as severe. Minor crashes were reduced by 50% and property damage crashes increased by 40%. The increase in property damage crashes could be a result of hospitalisation, medically treated and minor crashes decreasing in crash severity but not being avoided entirely.

While conducting the site inspection, it was noted that the sight distances for the intersection from all approaches was very bad due to large trees lining the street. Along the eastern side of Mort St, the trees are actually in the parking bays with car parks being allocated between the trees as seen in figure 6.35. As seen in table 6.12, the majority of crashes occurring at the intersection are DCA code 101 which was the same as the other two intersections. DCA code 104 refers to a vehicle turning right into an intersection and colliding with a vehicle travelling through the intersection. Code 107 is when a vehicle turns left onto a road and is hit from behind from a vehicle already travelling along the road it turned onto, and 202 refers to a crash where a vehicle turning right collides with a vehicle travelling in the opposite direction along the street the vehicle is turning from.

DCA Codes	Number of Crashes Per Code
101	14
104	1
107	1
202	1

Table 6.12 DCA Codes for Mort and Taylor Street Intersection Crashes

Figure 6.35 Mort and Taylor Street Intersection, Taylor Street Approach.

Figure 6.36 Mort and Taylor Street Intersection, Mort Street Approach.

Figure 6.37 Mort and Taylor Street Intersection, Sight Distance

6.7 Speed Survey Analysis

The speed survey data attained from Toowoomba Regional Council was for Ballin Dr, Weetwood St, Lemway Ave, Leslie St and Tara St. A map showing the location of the streets and where the traffic counting device was located along the street can be seen in figure 6.38.

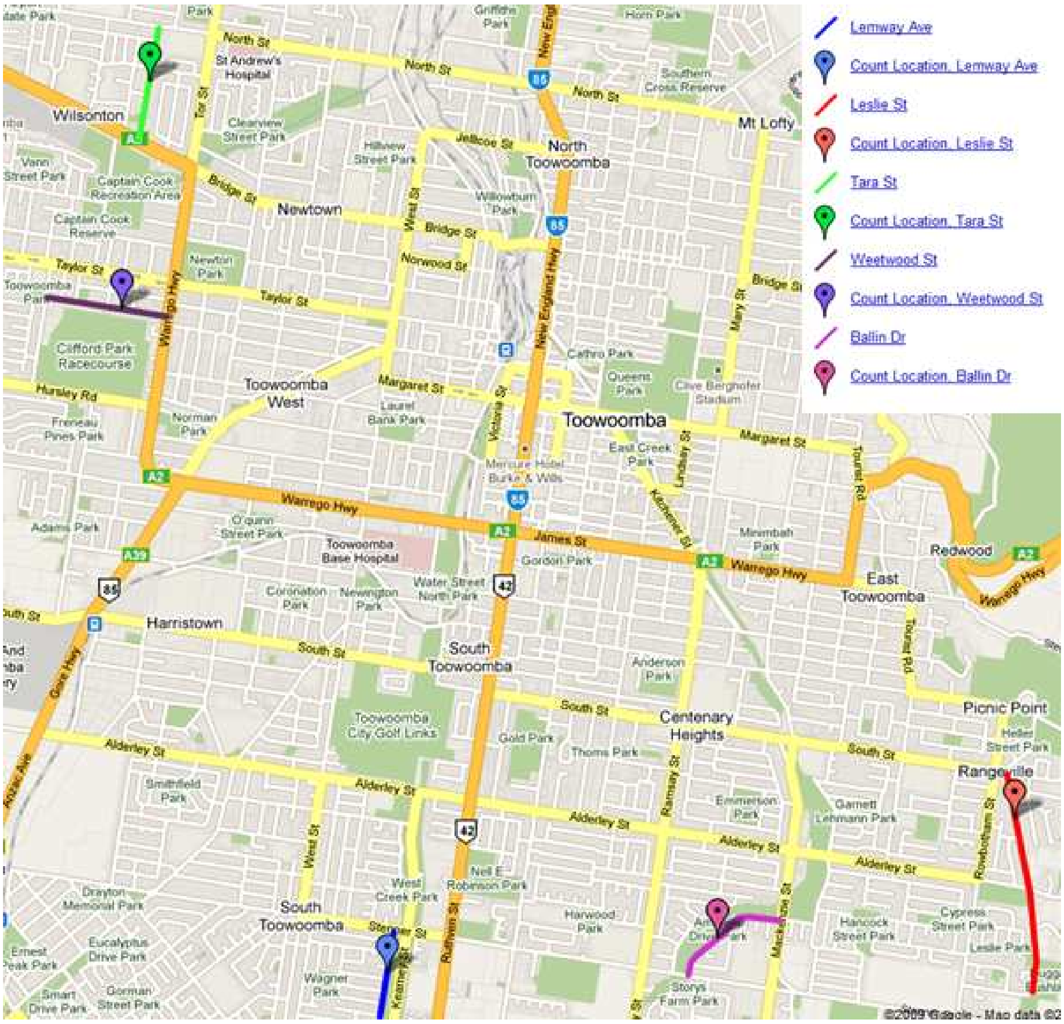

Figure 6.38 Speed Survey Streets and Count Locations

The traffic counts for these streets were recorded in November 2003, March 2003, August 2003 and February 2004. Before the 50km/h speed limit was introduced, the average 85th percentile speed was 63 km/h. In March 2003, 1 month after the 50km/h speed limit was introduced the 85th percentile speed was 60km/h. In August 2003, 6 months after it was introduced, the 85th percentile speed was

61km/h and in February 2003, 12 months after the implementation of the 50 km/h default urban speed limit the 85th percentile speed was 60km/h. This represents a decrease of 3km/h in the 85th percentile speed for local residential streets. Appendix M displays the 85th percentile speed for each street and the average 85th percentile speed, and the month it was recorded in.

Appendix N displays the percentage of vehicles travelling within the different speed groupings during the recorded time periods. It shows that 44% of drivers were happy to travel at speeds of between 50 to 60km/h, which was below or equal to the speed limit. Whereas after the 50km/h speed limit was introduced this value increased for the 1 and 6 month periods, then reduced to 43% 12 months after the 50km/h default urban speed limit was introduced. This represents that even 12 months after the 50km/h speed limit was introduced, 43% of drivers are exceeding the speed limit by 1 to 9km/h whereas before the 50km/h speed limit was introduced, only 25% of drivers were exceeding the speed limit by 1 to 9 km/h. Referring to appendix O, it can be seen that in November 2002, only 30% of drivers were speeding by any amount whereas in February 2004 (12 months after the 50km/h speed limit was introduced) 63% of drivers are exceeding the speed limit. Table 6.13 displays the average reduction in 85th percentile speeds for all 50km/h speed limit evaluations.

Location	Reduction in 85th Percentile Speed (km/h)
SE QLD	2.2
NSW	1.2
ACT	1.8
Victoria	1
Tasmania	N/A
Northern Territory	N/A
South Australia	1.4
Western Australia	0.8
Toowoomba	3

Table 6.13 Summary of 85th percentile Speed Reductions

6.8 Discussion of Results

Using the results displayed in table 6.2 for easy comparison, it can be seen that the 8% reduction in total crashes achieved by Toowoomba is close to the 13% reduction achieved for regional QLD which is what Toowoomba is classed as, and the 9% for the ACT. The similar results for these 3 areas could be attributed to the fact that the three areas have the smallest populations, of the areas evaluations were carried out for. The 28% reduction in pedestrian crashes for Toowoomba was the 2nd highest reduction in pedestrian crashes, only being beaten by WA with a massive 51% reduction in pedestrian crashes. A result of 28% was a considerable result for Toowoomba, especially taking into account that making Toowoomba's streets more pedestrian friendly was a primary aim of the 50km/h default urban speed limit.

Within table 6.2 there are 3 main sets of figures which may initially appear unexpected. These are the 3 negative values displaying a rise in crashes for all hospitalisation and property damage crashes, and for medically treated crashes involving pedestrians. The 3% increase in property damage crashes amounts to an increase of 0.7 property damage crashes per 10,000 people, and the decrease of 30% in medically treated crashes and 39% of minor injury crashes equates to a combined decrease of 7 crashes per 10,000. If 10% of medically treated and minor injury crashes could not be avoided entirely due to the speed limit increase and instead decreased in severity to property damage crashes, this would explain the 3% increase in property damage crases.

For the 115% increase in medically treated pedestrian crashes, a similar trend can be established. Before the 50km/h speed limit was changed was 2 hospitalisation pedestrian crashes per 10,000 and after there was only 0.5 whereas for medically treated crashes there was 0.6 before and 1.2 afterwards. If 50% of the hospitalisation crashes were avoided and the other 50% reducing in severity to medically treated crashes, this explains the 115% increase. The pedestrian crashes were not decreased in severity to minor crashes because unlike vehicles there is not much protection for the pedestrian. This is not the case for the 17% increase in total hospitalisation crashes as the amount of fatal crashes occurring after the 50km/h speed limit changed, increased as well. The problem with hospitalisation crashes is that there was a significant decrease in hospitalisation crashes in 2002 as seen in figure 6.5, throwing off any crash predictions.

When looking at the monetary values associated with crashes and the savings attained by the speed limit reduction shown in table 6.4, the effectiveness of the speed limit reduction becomes even more valuable as money pays an important part in evaluating the effectiveness of any government initiative. When you take into account this was for one town with a population of under 100,000 people in a country with a population over 21,000,000 there is a great amount of money to be saved by the government if it is in effect nationwide.

When conducting site inspections of roads and intersections where crashes regularly occurred, one of the features that was common with most Toowoomba streets was the amount that were lined with large trees which greatly affected the sight distances at intersections. This lack of visibility makes it harder to see pedestrians entering the road, as well as cars, considering that driveways and on-street parking are frequently located in between trees. Toowoomba is regarded as the garden city and the trees do add to the visual appearance and feel of the city, but they may be increasing the risk of crashes occurring.

The implementation of the 50km/h speed limit only reduced the 85th percentile speed on local residential streets by 3km/h. Considering that the speed limit was decreased by 10km/h, a reduction of 3km/h in driver speed would not be considered a good result. However when the reduction in 85th percentile speed is compared with the results of the other 50km/h speed limit evaluations (as displayed in table 6.13), a reduction of 3km/h is could be viewed as positive, when considering that the next highest reduction in speed compared to Toowoomba was South-East Queensland with a reduction of 2.2km/h.

Even though the reduction by 3km/h in driver speed is a positive result by comparison, more work could be pursued to ensure a greater portion of the population follow the actual speed limit, as 63% of drivers are still exceeding the 50km/h speed limit. This could be done by implementing physical speed calming devices such as speed humps, cement blisters or chicanes to name a few. The limitations of these treatments are that they are usually quite expensive and often cause annoyance to drivers. Another method to reduce the speed on streets could be to have a stronger police presence on Toowoomba streets. If the driving public notice regular police patrols they may be more likely to comply with the speed limit.

Chapter 7 Conclusion and Further Work

7.1 Conclusion

The Government's primary aim for implementing the 50km/h default urban speed was to reduce the amount and severity of crashes on local streets, making local streets and communities safer and more pleasant for everyone (Queensland Government 2003 [Brochure]). Referring to table 6.2, it is noticeable that the 50km/h default urban speed limit was effective, reducing the total amount of crashes by 8%, the amount of casualty crashes by 17% and total amount of crashes involving pedestrians by 28%. It was further noted that when a more in depth investigation was done, the sites where most crashes occurred before the 50km/h speed limit were introduced were not the same where the most crashes occurred after the speed limit reduction. On Vanity St for example, with 6 crashes (3 hospitalisation and 3 medically treated crashes) before the 50km/h speed limit was introduced, and no crashes afterwards. When looking at the cost effectiveness of 50km/h default urban speed limit for Toowoomba, a BCR of 7.6 and a saving of $2,989,729 can be regarded as a successful outcome. The results of the speed survey analysis displayed in table 6.13 show the 3km/h reduction in 85th percentile speed to be a greater reduction than achieved for other evaluations.

The effectiveness of the 50km/h default urban speed limit has benefited Toowoomba, as it has achieved its primary aim of reducing the amount and severity of crashes for vehicles and pedestrians. The safety imitative has also come out with a BCR greater than one, therefore generating savings greater than its capital implementation costs.

7.2 Further Work and Recommendations

While conducting this study, future work relating to the Toowoomba road network were recognised but were not investigated due to time and data restraints.

It was noticed that while the 50km/h default urban speed limit was effective in reducing the amount and severity of crashes on local residential streets, these crashes make up a small portion of the crashes that occur in Toowoomba. The crash data collected from Queensland Transport for Toowoomba City contained 6182 crash entries, of which 776 were used for the purpose of this report making up only 13% of all crashes in Toowoomba. To further reduce the amount and severity of crashes in Toowoomba, an in-depth evaluation of collector, sub-arterial or arterial roads could be under taken to identify ways to reduce the amount and severity of crashes on these roads which would affect a greater portion of the crashes that occur in Toowoomba.

When considering the speed survey information, it became apparent that further investigations have to be carried out into different ways of reducing the speed of vehicles travelling on local streets. It is one thing to assign the 50km/h speed limit to local streets, but making sure the public follow the speed limit is another.

When looking at the economic analysis of the 50km/h speed limit, it became quite apparent that the fatal 4 caused a significant amount of damage on 50km/h streets in Toowoomba. Similar if not higher results may also be found on streets with higher speed limits in Toowoomba. Further work could be conducted into researching other safety initiatives and public education campaigns that have been trialled in other parts of Australia and the world, to counter the amount of crashes caused by the fatal 4, and develop a more effective strategy for Toowoomba.

A follow up evaluation could be done on a different town of similar size and population in one of the other states or territories of Australia. The town needs to have a default urban speed limit of 50km/h or for a town of similar size and population in the Northern Territory, where the default urban speed limit is still 60 km/h. A comparison can then be done between Toowoomba and the town selected, as there would be more similarities between town evaluations than state wide evaluations.

Another area that could be looked at is the type of crashes that occur in Toowoomba. Using the DCA codes could be used to identify the most regularly recurring type of crash in Toowoomba and investigate methods of educating the Toowoomba population on how to handle that kind of crash situation or avoid it altogether.

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Appendix A

Project Specification

University of Southern Queensland

FACULTY OF ENGINEERING ARE SURVEYING

ENG 4111/4112 research project
PROJECT SPECIFICATION

For: Philip Baker

Topic: The 50 kph Speed Limit in Residential Toowoomba

Supervisors: Trevor Drysdale

Project Aim: The 50 kph road speed limit was introduced into Toowoomba in early 2003. The action was justified by the Queensland Government on the basis of road safety improvements and a reduction in road crashes. This project will seek to determine the effectiveness of the introduction of the 50 kph limit by examination of road crash data, residential speeds and other data.

Programme: Revision C, 16th of March 2009

1. Attain the relevant accident, crash and residential speeds data from the appropriate government authority.
2. Research background information on the desired effects the government hoped to achieve with the speed limit reduction on residential streets.
3. Analysis of the data, comparing the accident and crash data from before the implementation of the 50 kph, to that after the implementation.
4. Obtain another study undertaken on the effectiveness of the speed limit reduction, in a different Australian Town/City (or possibly overseas).
5. Compare other studies findings with my finding for the Toowoomba area.
6. Submit a Project Dissertation as detailed in course requirements.

As time permits

7. Attain additional studies undertaken on the effectiveness of the speed limit reduction, in different Australian Towns/Cities.
8. Compare other studies findings with my finding for the Toowoomba area

Agreed: PBaker (Student) TDrysdale (Supervisor)
Date: 16/03/09 17/03/09

Examiner / Co-examiner: [signature] 31/03/2009 [signature] 01/04/09

Appendix B

Sample of the Crash Data Supplied by Queensland Transport for Toowoomba City

#	Ref #	Month	Day	Year	CRASH_SEVERITY	CRASH_NATURE	ROADWAY_FEATURE	TRAFFIC_CONTROL
1	1	January	Monday	1998	Property damage	Angle	Intersection - Cross	Operating traffic lights
6	6	January	Monday	1998	Property damage	Angle	Intersection - Cross	Operating traffic lights
4529	4513	January	Monday	1998	Medical treatment	Rear-end	Intersection - T Junction	No traffic control
2	2	January	Tuesday	1998	Minor injury	Angle	Intersection - Cross	No traffic control
7	7	January	Tuesday	1998	Medical treatment	Angle	Intersection - Cross	Give way sign
2710	2675	January	Tuesday	1998	Property damage	Angle	Intersection - Cross	Give way sign
3657	3632	January	Tuesday	1998	Property damage	Hit object	Not applicable	No traffic control
8	8	January	Wednesday	1998	Property damage	Sideswipe	Intersection - T Junction	No traffic control
2707	2672	January	Wednesday	1998	Property damage	Angle	Intersection - Cross	Operating traffic lights
3659	3634	January	Wednesday	1998	Property damage	Angle	Not applicable	Give way sign
4530	4514	January	Wednesday	1998	Hospitalisation	Hit object	Intersection - T Junction	No traffic control
4	4	January	Thursday	1998	Property damage	Hit object	Not applicable	No traffic control
1909	1866	January	Thursday	1998	Property damage	Angle	Intersection - Cross	Stop sign
4531	4515	January	Thursday	1998	Property damage	Angle	Intersection - Cross	Operating traffic lights
4534	4518	January	Thursday	1998	Property damage	Angle	Intersection - Cross	Stop sign
3	3	January	Friday	1998	Property damage	Angle	Intersection - T Junction	No traffic control
5	5	January	Friday	1998	Property damage	Rear-end	Not applicable	No traffic control
1911	1868	January	Friday	1998	Hospitalisation	Hit object	Not applicable	No traffic control
1912	1869	January	Friday	1998	Hospitalisation	Angle	Intersection - Cross	Operating traffic lights
2708	2673	January	Friday	1998	Property damage	Hit object	Not applicable	No traffic control
4528	4512	January	Friday	1998	Property damage	Hit object	Not applicable	No traffic control

TRAFFIC_CONTROL	SPEED_LIMIT	DCA_CODE	CRASH_STREET	CRASH_STREET_ALSO_ON	Rsect Id
Operating traffic lights	60	101	Neil St	Warrego Hwy	18A
Operating traffic lights	60	202	Pechey St	Warrego Hwy	18B
No traffic control	60	301	Baynes St	West St	
No traffic control	60	202	New England Hwy	Perth St	22B
Give way sign	60	101	Warrego Hwy	Water St	18B
Give way sign	60	101	Hogg St	Mort St	
No traffic control	80	803	Warrego Hwy		18A
No traffic control	60	308	New England Hwy	Telford St	
Operating traffic lights	60	101	Bridge St	New England Hwy	22A
Give way sign	60	406	New England Hwy		22B
No traffic control	60	704	Conloi St	West St	
No traffic control	60	704	Healy St		
Stop sign	60	101	Campbell St	Mackenzie St	
Operating traffic lights	60	202	Alderley St	Anzac Ave	28A
Stop sign	60	101	Clairmont St	Russell St	
No traffic control	60	107	Goggs St	West St	
No traffic control	60	301	Warrego Hwy		18B
No traffic control	60	607	Warrego Hwy		18A
Operating traffic lights	60	202	Bridge St	Mary St	
No traffic control	60	704	Mooney St		
No traffic control	60	906	Anzac Ave		

Rsect Id	TDIST	SPEED_RELATED	ALCOHOL_DRUG	DRINK_DRIVER_RIDER	FATIGUE_RELATED	SPEEDING_DRIVER_RIDER	FAIL_GIVEWAY_STOP
18A	94.76	0	0	0	0	0	0
18B	0.49	0	0	0	0	0	0
		0	0	0	0	0	0
22B	0.43	0	0	0	0	0	0
18B	0.33	0	0	0	0	0	1
		0	0	0	0	0	1
18A	92.82	0	0	0	0	0	0
		0	0	0	0	0	0
22A	116.11	0	0	0	0	0	0
22B	2.93	0	0	0	0	0	1
		0	1	1	0	0	0
		0	0	0	0	0	0
		0	1	1	0	0	1
28A	1.95	0	0	0	0	0	0
		0	0	0	0	0	1
		0	0	0	0	0	1
18B	0.45	0	0	0	0	0	0
18A	91.77	0	0	0	0	0	0
		0	0	0	0	0	0
		0	1	1	0	0	0
		0	0	0	0	0	0

FAIL_GIVEWAY_STOP	DISOBEY_TRAFFIC_LIGHT_SIGN	ILLEGAL_MANOEUVRE	DANGEROUS_DRIVING	DISOBEY_ROAD_RULES_OTHER	INEXPERIENCE
0	1	0	0	0	0
0	0	1	0	0	0
0	0	0	1	0	0
0	0	1	0	0	0
1	0	0	0	0	1
1	0	0	0	0	0
0	0	0	0	0	0
0	0	1	0	0	0
0	1	0	0	0	0
1	0	0	0	0	0
0	0	0	1	0	0
0	0	0	0	0	1
1	0	0	0	0	0
0	0	1	0	0	0
1	0	0	0	0	1
1	0	0	0	0	0
0	0	0	1	0	0
0	0	0	0	0	1
0	0	1	0	0	0
0	0	0	1	0	0
0	0	0	0	0	0

INEXPERIENCE	DISTRACTED	OTHER_DRIVER_COND	AGE_LACK_PERCEPTION	RAIN_WET_ROAD	NEGLIGENCE	INATTENTION	ROAD_SURFACE
0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0
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0	0	0	0	0	0	0	0
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1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0

ROAD_SURFACE	ROAD_GRADIENT	ROAD_QUALITY	ROAD_WORKS	ROAD_OTHER	VEH_DEFECTS_MECHANICAL	VEH_DEFECTS_EXTERNAL
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0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
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0	0	0	0	0	0	0
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0	0	0	0	1	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

VEH_DEFECTS_EXTERNAL	OTHER_CIRCUMSTANCES	FATALITIES	HOSPITALISED	MEDICALLY_TREATED	MINOR_INJURIES	CASUALTY_TOTAL
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	1	0	1
0	0	0	0	0	1	1
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0	0	0	0	0	0	0
0	0	0	1	0	0	1
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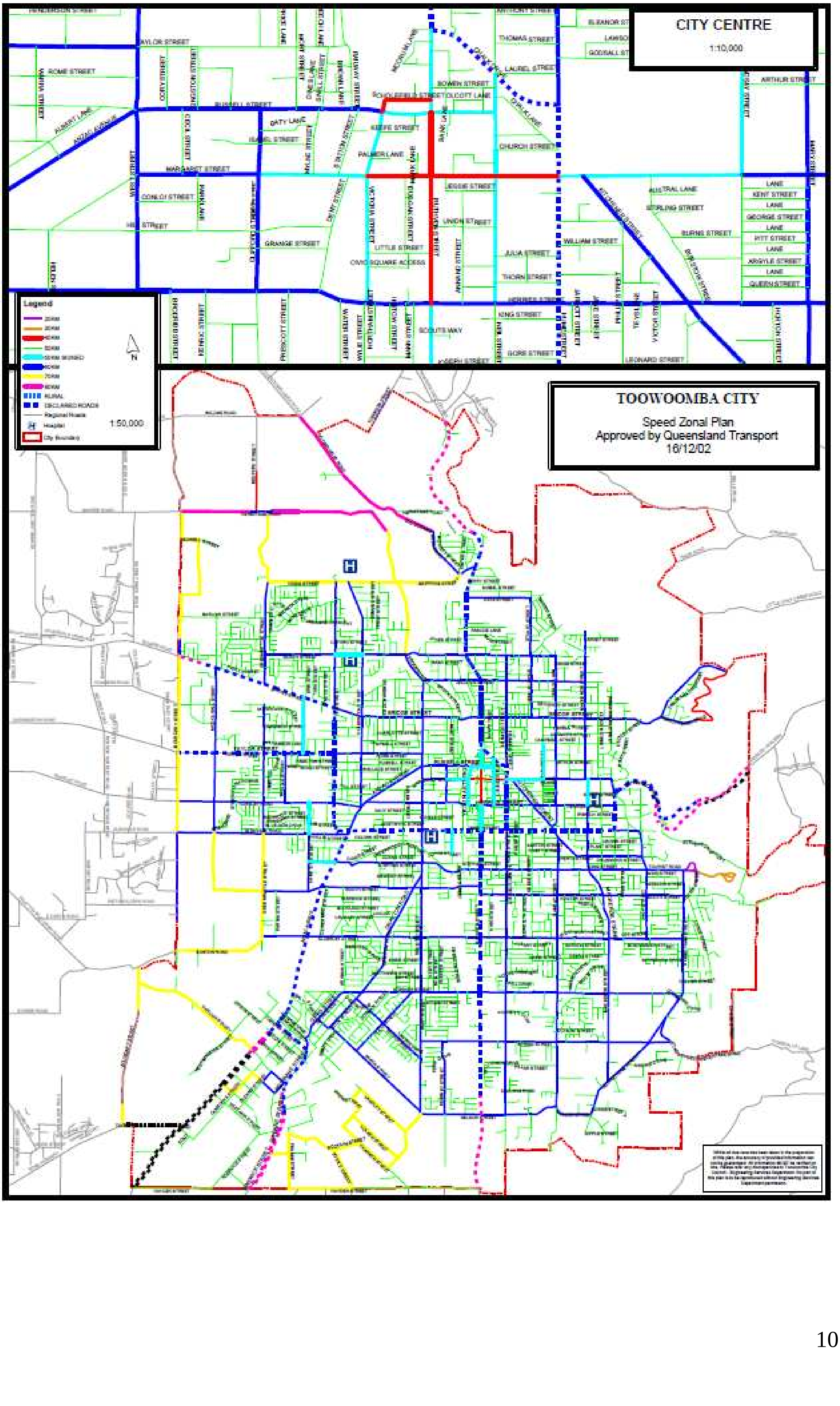
0	0	0	0	0	0	0

Appendix C

Toowoomba City Speed Zonal Plan


CITY CENTRE
1:10,000
Legend
1:50,000
TOOWOOMBA CITY
Speed Zonal Plan
Approved by Queensland Transport
16/12/02

Appendix D

Toowoomba City Road Network Dataset

Object ID	Length	Road Name	PS ID	Dyn ID	Road Type	Hierarchy	Wide Load	Speed Limit	Authority
1	43.942	BARDEN COURT	002017A		SEALED	LOCAL	0	50KM	TCC
2	61.607	LYDWIN CRESCENT	012068A		SEALED	LOCAL	0	50KM	TCC
3	80.836	BLAXLAND STREET	002080A	002080A	SEALED	LOCAL	0	50KM	TCC
4	486.493	RANGE STREET	018011A	018011A	SEALED	LOCAL	0	50KM	TCC
5	95.368	JANE STREET	010009A		SEALED	LOCAL	0	50KM	TCC
6	124.181	PRODUCTION COURT	016077A		SEALED	LOCAL	0	50KM	TCC
7	93.641	LAMB STREET	012003A		SEALED	LOCAL	0	50KM	TCC
8	47.027	WOMBYRA STREET	023069A		SEALED	LOCAL	0	50KM	TCC
9	112.047	DONAHUE STREET	004040A		SEALED	LOCAL	0	50KM	TCC
10	92.257	CABERNET COURT	003001A	003001A	SEALED	LOCAL	0	50KM	TCC
11	388.87	LYNDALL STREET	012070A	002151A	SEALED	LOCAL	0	50KM	TCC
12	258.588	PARKER STREET	016010C	016010A	SEALED	LOCAL	0	50KM	TCC
13	77.772	ANABA STREET	001028A	001028A	SEALED	LOCAL	0	50KM	TCC
14	151.922	WOLSELEY STREET	023068A		SEALED	LOCAL	0	50KM	TCC
15	71.811	DINES LANE	004032A		SEALED	LOCAL	0	50KM	TCC
16	141.573	RIFLE RANGE ROAD	018027C	018027C	SEALED	LOCAL	0	50KM	TCC
17	456.254	BROOK STREET	002127C		SEALED	LOCAL	0	50KM	TCC
18	375.252	LARGE STREET	012008A	012008A	SEALED	LOCAL	0	50KM	TCC
19	352.311	BUTT STREET	002155A		SEALED	LOCAL	0	50KM	TCC

Authority	Declared	From	To	Naasra	Score	Ward	Swcat	Length Par	Width Par
TCC	NO	MATTHEWS STREET	CUL-DE-SAC	9	1	5	WEST CREEK	51	6.4
TCC	NO	CAMPBELL STREET	LYDWIN CRESCENT (SOUTH)	9	1	2	GOWRIE CREEK	47	8
TCC	NO	WELLCAMP STREET	WYALLA STREET	8	2	4	BLACK GULLY	71	9.6
TCC	NO	MACKENZIE STREET	MARY STREET	8	2	3	ESCARPMENT	482	7.2
TCC	NO	GARGET STREET	HERRIES STREET	9	1	2	EAST CREEK	84	6.2
TCC	NO	GREENWATTLE STREET	CUL-DE-SAC	9	1	4	DRY CREEK	133	5.1
TCC	NO	MARGARET STREET	DUGGAN STREET	8	2	2	WEST CREEK	75	7
TCC	NO	ANZAC AVENUE	END	9	1	4	BLACK GULLY	44	7.8
TCC	NO	RUTHVEN STREET	CUL-DE-SAC	9	1	5	WEST CREEK	120	11
TCC	NO	WINE DRIVE	CUL-DE-SAC	9	1	3	GOWRIE CREEK	103	7.2
TCC	NO	ALDERLEY STREET	CROXLEY STREET	7	3	5	WEST CREEK	382	7.4
TCC	NO	GIPPS STREET	THE END	5	1	5	WESTBROOK CREEK	186	6
TCC	NO	NORTH STREET	CUDGEE COURT	8	2	3	BLACK GULLY	69	9.6
TCC	NO	NORTH STREET	MANSFORD STREET	9	1	3	GOWRIE CREEK	142	7.6
TCC	NO	FINCHLEY STREET	SNELL LANE	8	2	2	WEST CREEK	52	5.7
TCC	NO	MARTINI STREET	END	9	1	3	ESCARPMENT	137	7
TCC	NO	JELLICOE STREET	CUL-DE-SAC	9	1	3	GOWRIE CREEK	451	9.4
TCC	NO	ROWBOTHAM STREET	CUL-DE-SAC	9	1	1	ESCARPMENT	374	7.8
TCC	NO	ALDERLEY STREET	KOWALD STREET	9	1	5	WEST CREEK	349	7.8

Width Par	Date	Shape len
6.4		43.9426894
8		61.60758443
9.6		80.83540909
7.2		486.4920898
6.2		95.36794138
5.1		124.181198
7		93.64145106
7.8		47.0272867
11		112.0463606
7.2		92.25649975
7.4		388.8706589
6		258.5878622
9.6		77.77152115
7.6		151.9233287
5.7		71.81116285
7		141.5729868
9.4		456.2544633
7.8		375.2521723
7.8		352.3105332

Appendix E

Toowoomba Regional Traffic Count Data

Location	Ballin Drive (outside No. 30)						Ballin Drive - Off Tree outside No. 30	
Count No	1088		1123		1152		1183	
Start Date	12/11/2002		18/03/2003		12/08/2003		10/02/2004	
Duration	7 Days		7 Days		7 Days		7 Days	
Eastbound	8094		7833		7710		6820	
Westbound	7342		7129		7123		6046	
Total Vol.	15436		14962		14833		12866	
Speed Profile	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound
Posted Speed	60km/hr	60km/hr	50km/hr	50km/hr	50km/hr	50km/hr	50km/hr	50km/hr
85%ile Speed	65.2	63.4	63.4	60.5	62.6	60.8	64.1	62.6
Max. Speed	121	137	110	123	119	121	116	114
No. Speeding	3291	2207	6525	4943	6292	5335	5838	4793
% Speeding	40.66%	30.06%	83.30%	69.34%	81.61%	74.90%	85.60%	79.28%
Speed Bin 0-30	49	62	42	54	27	33	54	59
Speed Bin 30-40	102	160	145	196	127	155	135	143
Speed Bin 40-50	598	936	1121	1936	1264	1600	793	1051
Speed Bin 50-60	4054	3977	4186	3755	4244	3968	3483	3202
Speed Bin 60-70	2822	1917	2016	1040	1796	1218	2071	1382
Speed Bin 70-80	395	231	263	120	207	118	230	167
Speed Bin 80-90	60	43	41	20	28	25	38	29
Speed Bin 90-120	13	15	19	6	17	5	16	13
Speed Bin 120-150	1	1	0	2	0	1	0	0
Totals	**8094**	**7342**	**7833**	**7129**	**7710**	**7123**	**6820**	**6046**

Ballin Drive - Off Tree outside No. 30					
1183		1269		1322	
10/02/2004		5/02/2007		12/11/2007	
7 Days		7 Days		7 Days	
6820		7862		7851	
6046		7352		7244	
12866		15214		15095	
Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound
50km/hr	50km/hr	50km/hr	50km/hr	50km/hr	50km/hr
64.1	62.6	62.6	59.8	59.8	60.5
116	114	115	104	107	129
5838	4793	6149	4822	5171	4897
85.60%	79.28%	78.21%	65.59%	65.86%	67.60%
54	59	25	43	45	46
135	143	88	154	133	159
793	1051	1600	2333	2502	2142
3483	3202	4197	3706	4035	3687
2071	1382	1697	995	1019	1054
230	167	219	99	96	121
38	29	27	18	13	26
16	13	9	4	8	8
0	0	0	0	0	1
6820	**6046**	**7862**	**7352**	**7851**	**7244**

Location	**Lemway Ave (off pole outside No's 17 and 19)**							
Count No	1081		1116		1145		1176	
Start Date	4/11/2002		10/03/2003		4/08/2003		2/02/2004	
Duration	7 Days	5/7 Day 24Hr Ave	7 Days	5/7 Day 24Hr Ave	7 Days	5/7 Day 24Hr Ave	7 Days	5/7 Day 24Hr Ave
Northbound	3552	(???) & (???)	3774	(???) & (???)	3706	(???) & (???)	3701	(???) & (???)
Southbound	4149	(???) & (???)	4171	(???) & (???)	4238	(???) & (???)	4270	(???) & (???)
Total Vol.	7701		7945		7944		7971	
Speed Profile	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Posted Speed	60km/hr	60km/hr	50km/hr	50km/hr	50km/hr	50km/hr	50km/hr	50km/hr
85%ile Speed	64.8	62.6	61.6	60.5	63.0	60.5	60.8	59.4
Max. Speed	105	125	117	99	125	107	105	123
No. Speeding	1144	1018	2287	2482	2469	2575	2057	2315
% Speeding	32.21%	24.54%	60.60%	59.51%	66.62%	60.76%	55.58%	54.22%
Speed Bin 0-30	75	69	69	83	77	70	129	87
Speed Bin 30-40	428	353	486	380	438	373	520	459
Speed Bin 40-50	600	963	932	1226	722	1220	995	1409
Speed Bin 50-60	1305	1746	1532	1780	1535	1833	1381	1721
Speed Bin 60-70	919	831	635	588	781	625	580	498
Speed Bin 70-80	185	143	101	95	117	95	79	75
Speed Bin 80-90	35	33	14	14	30	13	13	11
Speed Bin 90-120	5	10	5	5	5	9	4	10
Speed Bin 120-150	0	1	0	0	1	0	0	0
Totals	**3552**	**4149**	**3774**	**4171**	**3706**	**4238**	**3701**	**4270**

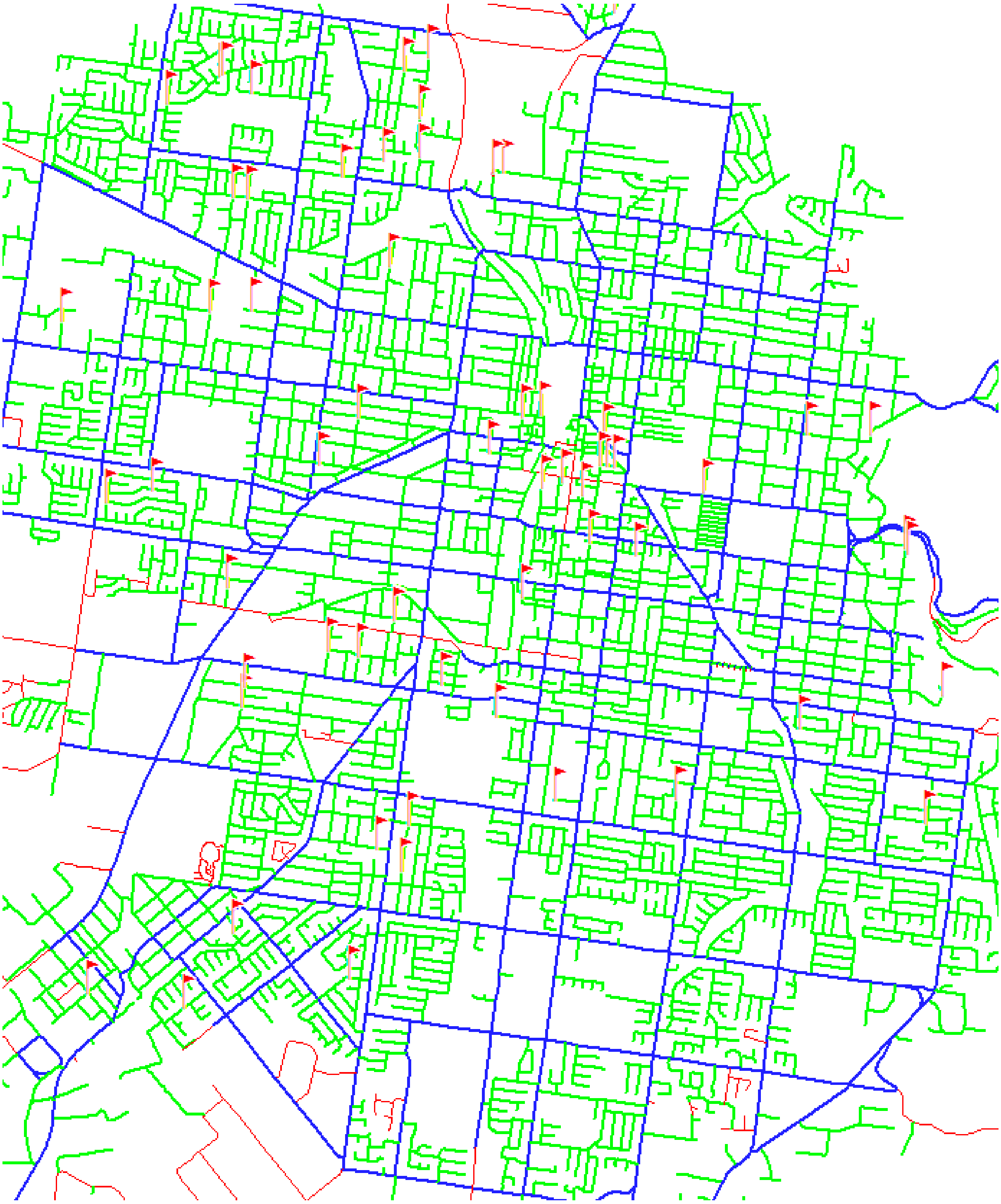
Location	**Leslie Street (South - Alderley Streets - off pole outside No's 18 and 20)**							
Count No	1080		1115		1144		1175	
Start Date	4/11/2002		10/03/2003		4/08/2003		2/02/2004	
Duration	7 Days	5/7 Day 24Hr Ave	7 Days	5/7 Day 24Hr Ave	7 Days	5/7 Day 24Hr Ave	7 Days	5/7 Day 24Hr Ave
Northbound	2018	(???) & (???)	2056	(???) & (???)	1972	(???) & (???)	1929	(???) & (???)
Southbound	1842	(???) & (???)	1870	(???) & (???)	1884	(???) & (???)	1998	(???) & (???)
Total Vol.	3860		3926		3856		3927	
Speed Profile	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Posted Speed	60km/hr	60km/hr	50km/hr	50km/hr	50km/hr	50km/hr	50km/hr	50km/hr
85%ile Speed	63.7	61.2	60.1	56.9	60.8	59.0	59.0	58.7
Max. Speed	108	123	137	126	105	141	92	109
No. Speeding	513	330	1162	702	1155	880	972	875
% Speeding	25.42%	17.92%	56.52%	37.54%	58.57%	46.71%	50.39%	43.79%
Speed Bin 0-30	38	62	42	62	47	65	57	73
Speed Bin 30-40	146	214	157	273	148	219	214	287
Speed Bin 40-50	484	676	695	833	622	720	686	763
Speed Bin 50-60	837	560	836	524	797	632	717	622
Speed Bin 60-70	414	244	264	147	294	199	211	190
Speed Bin 70-80	81	63	47	19	58	37	37	38
Speed Bin 80-90	15	17	8	5	4	4	6	13
Speed Bin 90-120	3	5	6	6	2	7	1	12
Speed Bin 120-150	0	1	1	1	0	1	0	0
Totals	**2018**	**1842**	**2056**	**1870**	**1972**	**1884**	**1929**	**1998**

Location	**Tara Street (off tree outside No. 37)**							
Count No	1077		1112		1141		1172	
Start Date	4/11/2002		10/03/2003		4/08/2003		2/02/2004	
Duration	7 Days	5/7 Day 24Hr Ave	7 Days	5/7 Day 24Hr Ave	7 Days	5/7 Day 24Hr Ave	7 Days	5/7 Day 24Hr Ave
Northbound	3715	(???) & (???)	2176	(???) & (???)	3635	(???) & (???)	3873	(???) & (???)
Southbound	3836	(???) & (???)	1732	(???) & (???)	3689	(???) & (???)	4024	(???) & (???)
Total Vol.	7551		3908		7324		7897	
Speed Profile	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Posted Speed	60km/hr	60km/hr	50km/hr	50km/hr	50km/hr	50km/hr	50km/hr	50km/hr
85%ile Speed	64.1	63.7	58.0	57.6	59.8	58.7	59.8	59.0
Max. Speed	124	116	95	83	99	108	104	106
No. Speeding	1112	1091	1033	857	2056	1954	2105	2238
% Speeding	29.93%	28.44%	47.47%	49.48%	56.56%	52.97%	54.35%	55.62%
Speed Bin 0-30	117	117	64	78	116	148	123	145
Speed Bin 30-40	250	194	265	145	315	284	378	335
Speed Bin 40-50	798	815	814	652	1148	1303	1267	1306
Speed Bin 50-60	1438	1619	810	695	1507	1504	1538	1710
Speed Bin 60-70	921	898	203	141	483	385	498	464
Speed Bin 70-80	158	156	14	18	55	55	62	50
Speed Bin 80-90	25	24	5	3	7	7	3	10
Speed Bin 90-120	7	13	1	0	4	3	4	4
Speed Bin 120-150	1	0	0	0	0	0	0	0
Totals	**3715**	**3836**	**2176**	**1732**	**3635**	**3689**	**3873**	**4024**

Location	**Weetwood St (Wyalla - Tor Sts - off tree outside No 29)**							
Count No	1086		1121		1150		1181	
Start Date	12/11/2002		18/03/2003		12/08/2003		10/02/2004	
Duration	7 Days	5/7 Day 24Hr Ave	7 Days	5/7 Day 24Hr Ave	7 Days	5/7 Day 24Hr Ave	7 Days	5/7 Day 24Hr Ave
Eastbound	2298	(???) & (???)	2328	(???) & (???)	2217	(???) & (???)	2603	(???) & (???)
Westbound	1898	(???) & (???)	1957	(???) & (???)	1881	(???) & (???)	2149	(???) & (???)
Total Vol.	4196		4285		4098		4752	
Speed Profile	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound
Posted Speed	60km/hr	60km/hr	50km/hr	50km/hr	50km/hr	50km/hr	50km/hr	50km/hr
85%ile Speed	63.0	62.6	59.4	61.2	60.1	60.8	59.8	60.8
Max. Speed	110	92	115	100	94	99	118	100
No. Speeding	556	461	1322	1271	1294	1132	1348	1160
% Speeding	24.19%	24.29%	56.79%	64.95%	58.37%	60.18%	51.79%	53.98%
Speed Bin 0-30	87	82	82	60	73	58	129	137
Speed Bin 30-40	158	129	196	134	205	144	298	234
Speed Bin 40-50	562	458	728	492	645	547	828	618
Speed Bin 50-60	935	768	981	902	938	791	959	775
Speed Bin 60-70	464	400	293	331	302	299	315	324
Speed Bin 70-80	73	50	39	29	47	37	59	48
Speed Bin 80-90	13	10	6	5	5	4	11	12
Speed Bin 90-120	6	1	3	4	2	1	4	1
Speed Bin 120-150	0	0	0	0	0	0	0	0
Totals	**2298**	**1898**	**2328**	**1957**	**2217**	**1881**	**2603**	**2149**

Appendix F

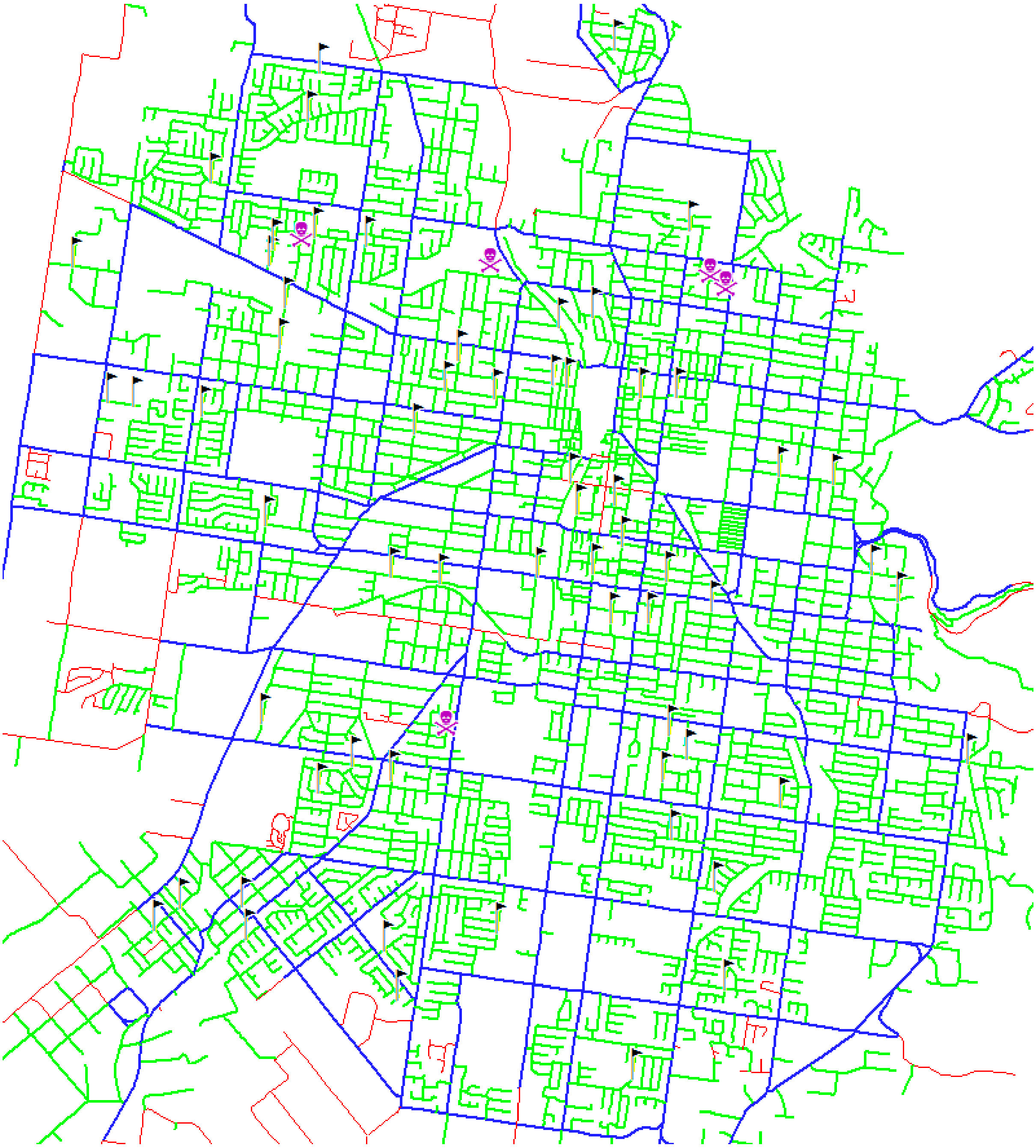
Hospitalisation and Fatal Crashes Before



Hospitalisation Crash

Appendix G

Hospitalisation and Fatal Crashes After



Fatal Crash

Hospitalisation Crash

Appendix H

All Crashes with Current Population

Year	Population	Fatalities	Hospitalisation	Medically Treated	Minor Injury	Casualty Crashes	Property Damage	Total Crashes
1998	87,429	0	11	8	8	27	38	65
1999	87,969	0	13	11	4	28	22	50
2000	88,870	0	10	14	11	35	38	73
2001	90,027	0	16	10	8	34	29	63
2002	90,971	0	9	18	13	40	45	85
2003	92,054	0	13	12	6	31	50	81
2004	93,299	1	16	20	12	49	48	97
2005	95,076	3	16	22	6	47	62	109
2006	96,193	0	12	14	12	38	38	76
2007	96,326	1	12	13	14	40	37	77

Appendix I

All Crashes with Scaled Population

Year	Population	Fatalities	Hospitalisation	Medically Treated	Minor Injury	Casualty Crashes	Property Damage	Total Crashes
1998	10,000	0.00	1.26	0.92	0.92	3.09	4.35	7.43
1999	10,000	0.00	1.48	1.25	0.45	3.18	2.50	5.68
2000	10,000	0.00	1.13	1.58	1.24	3.94	4.28	8.21
2001	10,000	0.00	1.78	1.11	0.89	3.78	3.22	7.00
2002	10,000	0.00	0.99	1.98	1.43	4.40	4.95	9.34
2003	10,000	0.00	1.41	1.30	0.65	3.37	5.43	8.80
2004	10,000	0.11	1.71	2.14	1.29	5.25	5.14	10.40
2005	10,000	0.32	1.68	2.31	0.63	4.94	6.52	11.46
2006	10,000	0.00	1.25	1.46	1.25	3.95	3.95	7.90
2007	10,000	0.10	1.25	1.35	1.45	4.15	3.84	7.99

Appendix J

Pedestrian Crashes with Current Population

Year	Population	Fatalities	Hospitalisation	Medically Treated	Minor Injury	Casualty Crashes	Property Damage
1998	87,429	0	2	0	0	2	2
1999	87,969	0	2	1	0	3	3
2000	88,870	0	4	2	0	6	6
2001	90,027	0	6	0	1	7	7
2002	90,971	0	0	1	0	1	1
2003	92,054	0	1	3	0	4	4
2004	93,299	0	3	1	0	4	4
2005	95,076	1	0	2	0	3	3
2006	96,193	0	0	3	0	3	3
2007	96,326	1	1	2	1	5	5

Appendix K

Pedestrian Crashes with Scaled Population

Year	Population	Fatalities	Hospitalisation	Medically Treated	Minor Injury	Casualty Crashes	Property Damage
1998	10,000	0.00	0.23	0.00	0.00	0.23	0.23
1999	10,000	0.00	0.23	0.11	0.00	0.34	0.34
2000	10,000	0.00	0.45	0.23	0.00	0.68	0.68
2001	10,000	0.00	0.67	0.00	0.11	0.78	0.78
2002	10,000	0.00	0.00	0.11	0.00	0.11	0.11
2003	10,000	0.00	0.11	0.33	0.00	0.43	0.43
2004	10,000	0.00	0.32	0.11	0.00	0.43	0.43
2005	10,000	0.11	0.00	0.21	0.00	0.32	0.32
2006	10,000	0.00	0.00	0.31	0.00	0.31	0.31
2007	10,000	0.10	0.10	0.21	0.10	0.52	0.52

Appendix L

Crash Costs

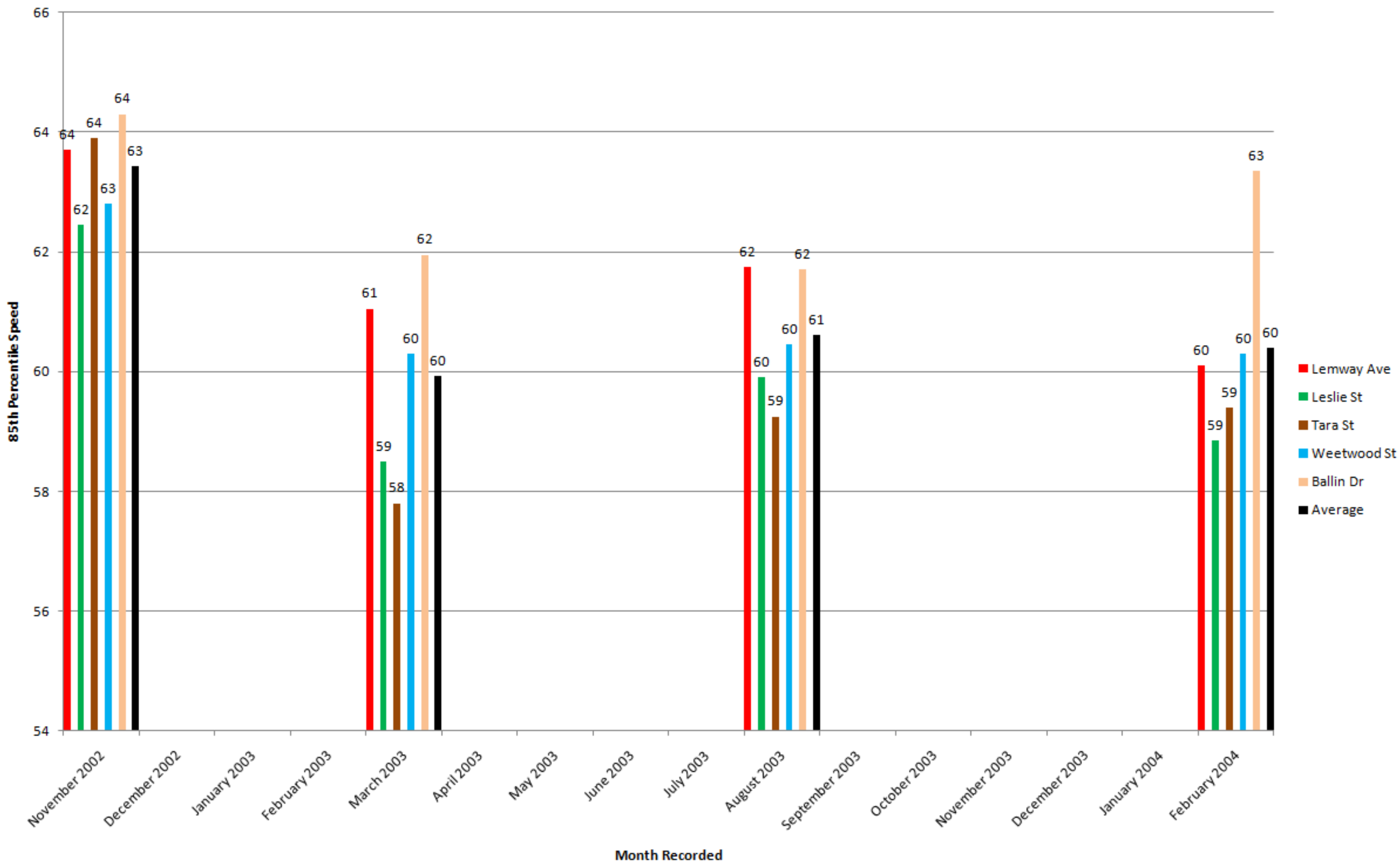
Cost Per crash			$5,808.00				$1,652,994.00			
Year	Population	CPI	Property Damage				Fatal			
			Observed		Extrapolated		Observed		Extrapolated	
			No. of Crashes	Cost	No. of Crashes	Cost	No. of Crashes	Cost	No. of Crashes	Cost
2003	92053.5	1.14	5.43	$331,154.86	4.46	$271,691.38	0.00	$0.00	0.00	$0.00
2004	93299	1.17	5.14	$325,564.77	4.65	$294,155.28	0.11	$1,930,371.23	0.00	$0.00
2005	95076	1.20	6.52	$430,374.94	4.84	$319,459.95	0.32	$5,926,812.83	0.00	$0.00
2006	96192.5	1.21	3.95	$268,110.62	5.03	$341,557.68	0.00	$0.00	0.00	$0.00
2007	96326	1.24	3.84	$265,651.03	5.22	$361,338.85	0.10	$2,043,404.98	0.00	$0.00
Total Costs Per Casualty Type				$1,620,856.22		$1,588,203.13		$9,900,589.03		$0.00

$407,990.00				$407,990.00			
Hospital				Medically			
Observed		Extrapolated		Observed		Extrapolated	
No. of Crashes	Cost	No. of Crashes	Cost	No. of Crashes	Cost	No. of Crashes	Cost
1.41	$6,048,217.35	1.30	$5,561,599.89	1.30	$5,582,969.86	2.05	$8,764,252.28
1.71	$7,623,230.65	1.27	$5,666,803.08	2.14	$9,529,038.31	2.25	$9,980,472.44
1.68	$7,801,860.51	1.25	$5,799,711.76	2.31	$10,727,558.21	2.44	$11,330,532.02
1.25	$5,947,501.84	1.23	$5,850,727.86	1.46	$6,938,752.15	2.64	$12,599,660.68
1.25	$6,052,209.24	1.20	$5,846,368.98	1.35	$6,556,560.01	2.84	$13,805,087.34
	$33,473,019.60		$28,725,211.57		$39,334,878.54		$56,480,004.75

$13,776.00			
Minor			
Observed		Extrapolated	
No. of Crashes	Cost	No. of Crashes	Cost
0.65	$94,255.98	1.44	$208,035.77
1.29	$193,051.84	1.58	$237,872.45
0.63	$98,787.74	1.73	$270,969.11
1.25	$200,820.57	1.88	$302,189.04
1.45	$238,415.42	2.02	$331,918.59
	$825,331.55		$1,350,984.96

Appendix M

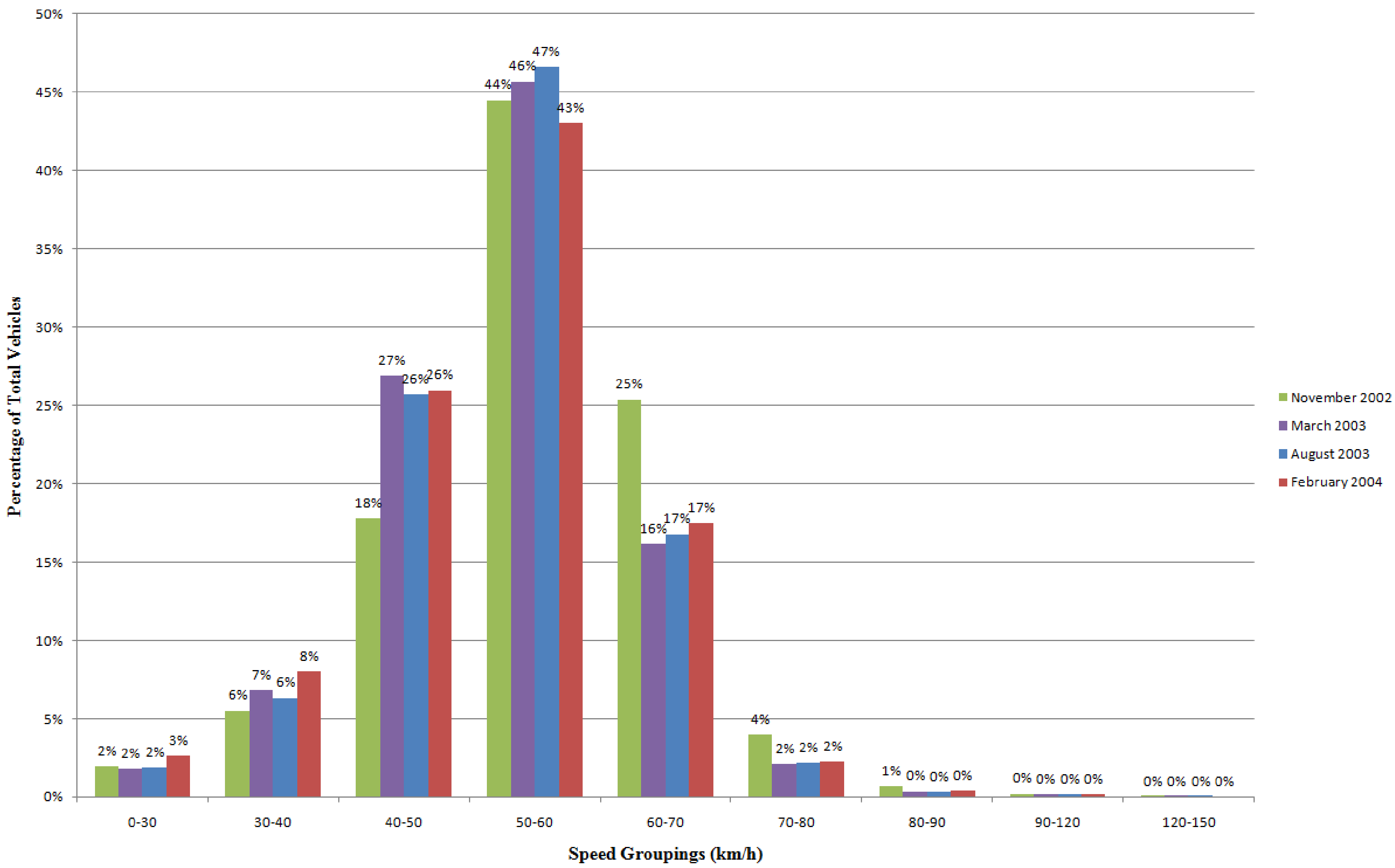
85th Percentile Speed for Recorded Streets



85th Percentile Speed
66
64
62
60
58
56
54
64
62
64
63
64
63
61
59
58
60
62
60
62
60
59
60
62
61
60
59
59
60
63
60
November 2002
December 2002
January 2003
February 2003
March 2003
April 2003
May 2003
June 2003
July 2003
August 2003
September 2003
October 2003
November 2003
December 2003
January 2004
February 2004
Month Recorded
Lemway Ave
Leslie St
Tara St
Weetwood St
Ballin Dr
Average

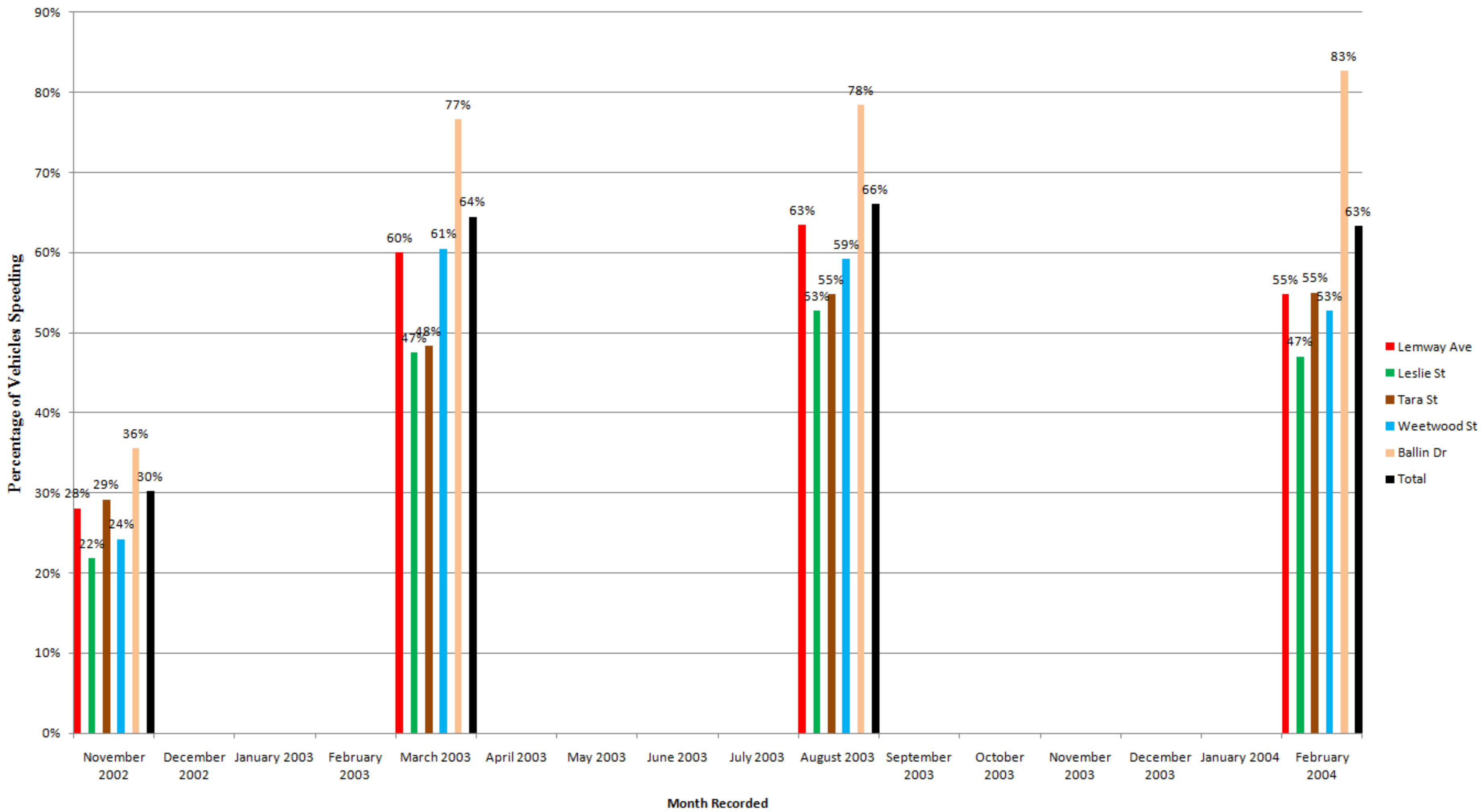
Appendix N

Percentage of Vehicles Travelling at Different Speed Groupings


Percentage of Total Vehicles
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
2% 2% 2% 3%
6% 7% 6% 8%
18% 27% 26% 26%
44% 46% 47% 43%
25% 16% 17% 17%
4% 2% 2% 2%
1% 0% 0% 0%
0% 0% 0% 0%
0% 0% 0% 0%
0-30
30-40
40-50
50-60
60-70
70-80
80-90
90-120
120-150
Speed Groupings (km/h)
November 2002
March 2003
August 2003
February 2004

Appendix O

Percentage of Vehicles Speeding



Percentage of Vehicles Speeding
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
28%
22%
29%
24%
36%
30%
60%
47%
48%
61%
77%
64%
63%
53%
55%
59%
78%
66%
55%
47%
55%
53%
83%
63%
November 2002
December 2002
January 2003
February 2003
March 2003
April 2003
May 2003
June 2003
July 2003
August 2003
September 2003
October 2003
November 2003
December 2003
January 2004
February 2004
Month Recorded
Lemway Ave
Leslie St
Tara St
Weetwood St
Ballin Dr
Total