University of Southern Queensland
Faculty of Engineering and Surveying

Investigation of Toowoomba Intersection Crashes

A dissertation submitted by

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towards the degree of

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Abstract

Today's society puts a large emphasis on reducing road crash rates because of the high financial and social costs which are largely preventable. The main project aim is to identify suitable engineering treatments that can be applied to problem intersections of Toowoomba City by use of a classification method.

Most of Toowoomba is based on the grid street pattern, with a somewhat fragmented road hierarchy. High connectivity is provided, but this can cause a mixing of different traffic purposes and variability.

This project takes an approach of developing and applying a derived intersection classification system which allows the charting and analysis of intersection crash data by intersection class.

Such analysis relies heavily on the integrity of the data received and the assumptions applied. Many crash data discrepancies were found and outcomes were influenced by the intersection classification system adopted and subsequent intersection groupings used.

Due to the high variability of intersections and traffic behaviour, the application of intersection remedial treatments is still best left to a case by case basis. However there maybe some scope for grouping of intersections. Further development will require more refinement of the classification system and analysis of a bigger crash data set.

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ENG4111 Research Project Part 1 &
ENG4112 Research Project Part 2

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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.

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Signature

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Date

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Abbreviations

AADT	Average Annual Daily Traffic
ABS	Australian Bureau of Statistics
ARMIS	A Road Management Information System
ARRB	Australian Road Research Board
AS	Australian Standards
DCA	Definition for Coding Accidents
GIS	Geographical Information System
km	Kilometre
km/h	Kilometres per hour
m	Metre
DMR	Queensland Department of Main Roads
QT	Queensland Department of Transport
RC2	Road Crash 2 (software)
RPC	Reference Point Code
TARP	Traffic Accident Remedial Program
TARS	Traffic Analysis and Reporting System
TCC	Toowoomba City Council
vkt	Vehicle Kilometres Travelled
vpd	Vehicles per day

1 Introduction

Of all the human transport systems, motorised transport on road networks is by far the most common method in Australia. The quality of life for a society relies on a capable transport system to connect communities with goods, services and employment. This quest for mobility causes considerable risk of collision between road users. Substantial resources are devoted to road safety throughout the developed world in a bid to eliminate the ‘Road Crash’. However total elimination of the ‘Road Crash’ is not currently possible whilst human control is involved and traffic volumes continuously increase. Therefore the focus of many research studies is towards reducing the frequency or severity of crashes.

Many studies have proven that intersections are among the most hazardous locations on road networks. They are inherently risky in cities due to the concentration of intersections per kilometre of roadway. Therefore intersections are a major consideration in a road network to accommodate safe traffic flow in all directions. To provide safe & efficient passage, intersections must be designed, maintained & managed correctly, if this is not achieved considerable congestion and crashes could occur.

To avoid collisions road uses must be separated either temporally (time) or spatially (space). The most common method employed is time separation by use of a signalised intersection. Spatial separation is achieved with grade separation, where vehicles can travel on ramps to effectively go above and beneath each other. Due to the cost and land area required, the construction of grade separated crossings is limited to high volume and high level of service areas, none of which exist in Toowoomba (except for some railway intersections).

1.1 Outline of the Study

It has been determined that road crashes at intersections account for an unacceptably high proportion of hospitalisation crashes in the Darling Downs region of Queensland. In Toowoomba itself, 64% of all road crashes occur at intersections of which, 24% cause a hospitalisation or a fatality.

This project titled "Investigation of Toowoomba Intersection Crashes", will aim to identify hazardous road intersection types within Toowoomba and determine efficient remedial treatment recommendations in order to achieve a reduction in the frequency and/or severity of crashes at particular types of intersections.

1.2 Study area

1.2.1 Toowoomba City

Toowoomba is situated at a latitude and longitude of 27°33′S 151°57′E, approximately 130km west of Queensland's capital city, Brisbane. A rough depiction is shown in the figure below. According to a 2003 ABS estimate, Toowoomba is Australia's second largest inland city after Canberra, with a population of 113,687 (Wikipedia 2006).

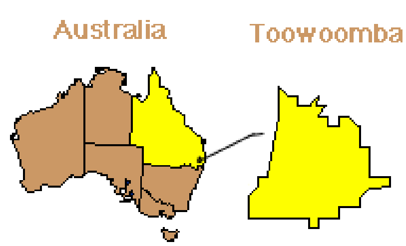


Figure 1-1: Location of Toowoomba, Queensland
Source: NRMW 2006

Queensland Department of Main Roads (DMR) is responsible for all State and Federal controlled roads in Toowoomba. All other streets and local roads within

Toowoomba's boundaries are managed by the Toowoomba City Council (TCC), a Local Government Authority (LGA).

The importance of the Toowoomba major road network is shown by the following: 'Toowoomba has a pivotal role in the region as a transport hub for the Darling Downs and beyond and is an important focal point for interstate and intrastate freight movement, being at the confluence of the Warrego, New England and Gore Highways. The city itself also generates major freight traffic…', (Maunsell 1997, p.1-2). These major highways all pass through Toowoomba's urban traffic zones and form part of the Australian or State Highway System, helping form the link between Brisbane, Sydney, Melbourne and Darwin.

The population for the City of Toowoomba was 95,956 with an approximate growth of 2.5% in 2005. The median age of residents was 33.5 years old in 2001, with the 20 to 34 year age bracket being the largest on 21.1% (Toowoomba Now 2006). The bar chart below shows the population distribution in both 2000 and 2005, for each of the five Statistical Local Areas (SLAs) comprising Toowoomba.

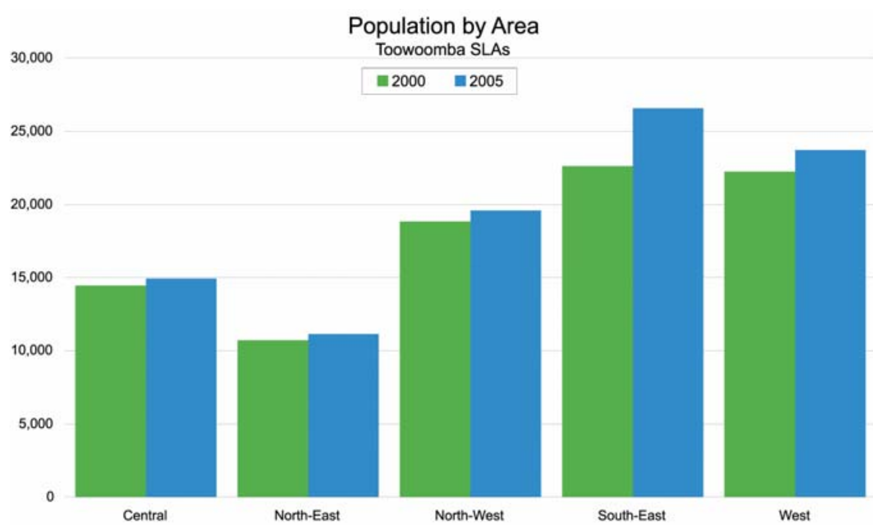


Figure 1-2: Toowoomba Population across five SLAs
Source: Toowoomba Now 2006

Motor vehicles registrations also grew in Toowoomba to a total of 64,901 as at

31 March 2004. The table below shows the numbers by basic vehicle type.

Table 1-1: Toowoomba Registrations 2004

Motor Vehicle Registrations, 2004	Level	Ann % chg
Passenger vehicles	49,370	2.3
Light commercial vehicles	10,816	2.5
Trucks	2,343	-0.3
Other	2,372	-3.5
Total	**64,901**	**2.0**

Source: Toowoomba Now 2006

Toowoomba's climate pattern features a dry winter and wet summer. The chart below best depicts the average monthly maximum & minimum temperatures and rainfall. The average annual rainfall in Toowoomba is 950mm (Toowoomba Now 2006).

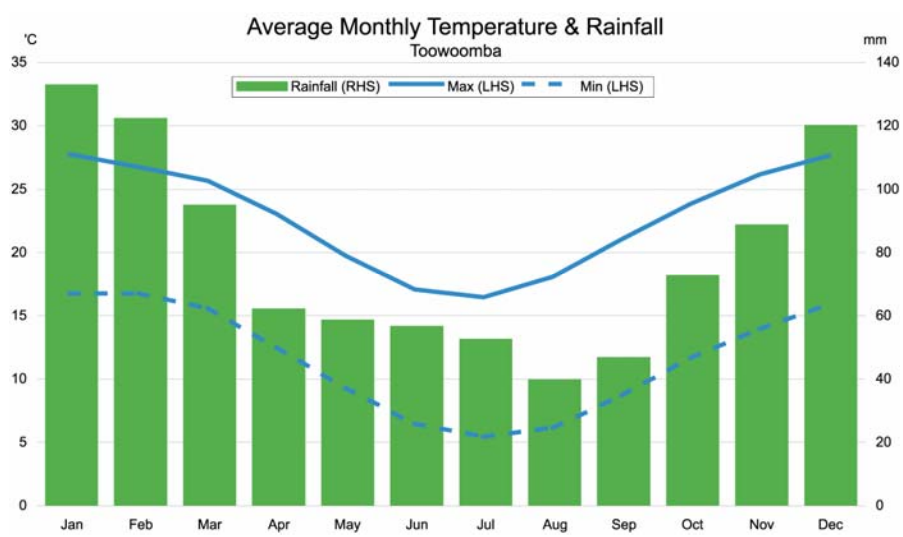


Figure 1-3: Toowoomba Temperatures & Rainfall
Source: Toowoomba Now 2006

1.2.2 Crash Study Area

The current study has been confined to the urban area within Toowoomba, because most intersection crashes in the region occur within the urban environment. Outside the city crashes tend to involve higher speed traffic without signalised intersections or roundabouts, therefore producing crashes of a different nature.

TCC's boundaries are the chosen geographical extents of this crash investigation. A diagram showing the location of Toowoomba's suburbs is shown below.

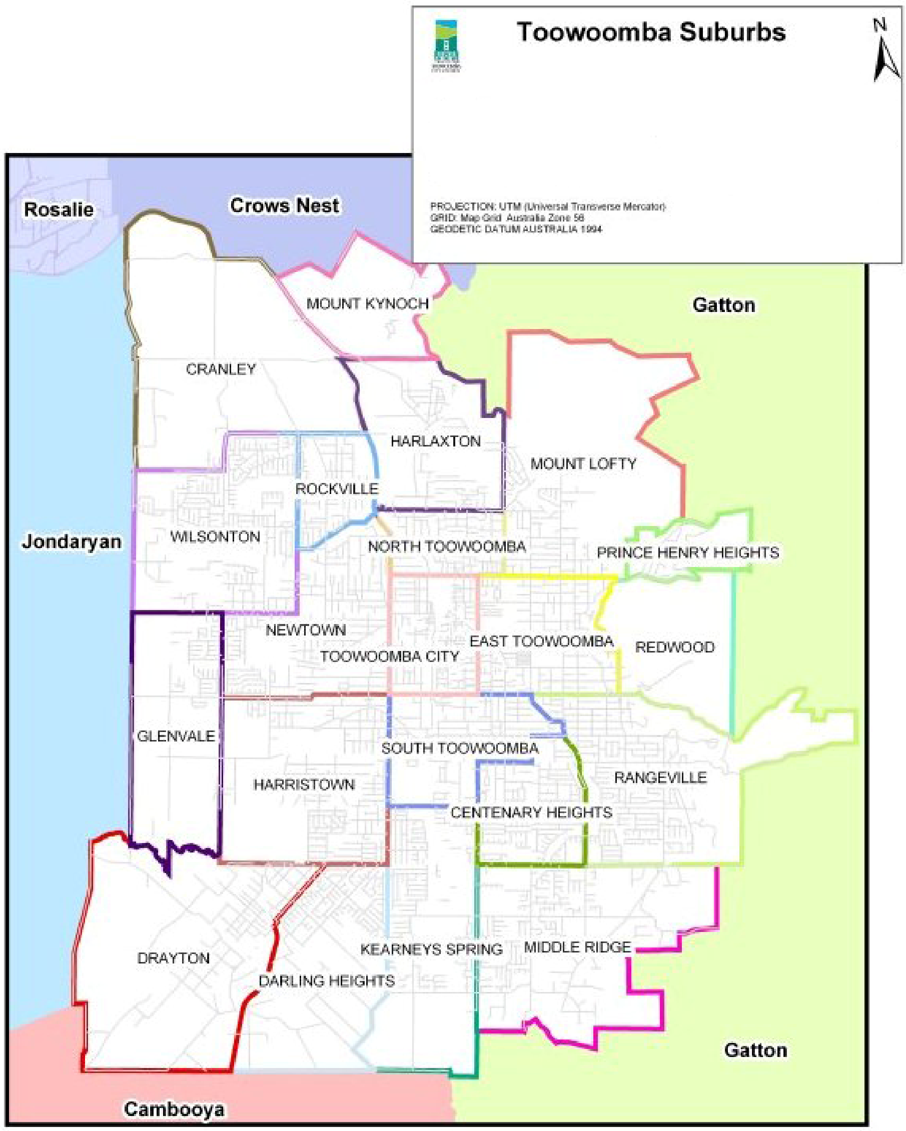


Figure 1-4: Toowoomba Suburbs
Source: Toowoomba City Council 2003

Land use in Toowoomba is diverse, with many primary and secondary industries playing a significant role in the economic development of a large area of Southern & South Western Queensland. Toowoomba covers 116sq km and is characterised by relatively low density residential land use, (Toowoomba Now 2006).

Toowoomba experiences relatively high proportions of heavy vehicles and some tourist traffic. Toowoomba also has numerous one way streets, hills and non-conventional intersections, all of which make it an interesting location for a crash investigation.

Although Toowoomba does not experience snow, the city is prone to fog and occasionally sleet in the winter months, which can degrade driving conditions. Both sight distances and tyre traction can be reduced by these conditions, adding to the possible crash risk.

1.3 Brief History of Toowoomba

This section has been included to help explain how the Toowoomba street network was developed giving an understanding of why it is so irregular in places. This section was mostly derived from the *Newtown Heritage and Character Study 2004*, as referenced.

The Darling Downs Queensland was originally settled because of its' very fertile soils which can grow all classes of crops. The original settlement was at Drayton as a stop-over mainly for transport, "teamsters" and "carriers". The first government survey of 1849 the "Drayton Swamp Agricultural Area" comprised twelve, twenty acre sections, was delineated between the present day West Street and the western edge of West Creek (bounded by present day West Street, Bridge Street and Stephen Street) to provide agricultural produce for the town of Drayton", (Ivan McDonald Architects 2004).

Lots of land speculation occurred in Toowoomba, which drove up values and interest in the area. “A new township was surveyed at The Swamp in 1853, principally embraced by East and West Creeks. A westward wave of development came shortly after Toowoomba was proclaimed a municipality in December 1860”, (Ivan McDonald Architects 2004).

Gradually the farming land was subdivided further, becoming residential land over time. The prominent estates were the Mort Estate (1862), Newtown Estate (1866) and Paddington Estate (1866).

Toowoomba’s structure was conforming to the typical 19th century Queensland town development pattern. “Boundary streets delineating the town reserve of one square mile or larger framed a square or rectangular grid with cardinal orientation. West, East, North and South Streets delineated the early Toowoomba town reserve. Remnant sections between the built-up core of the town and the town boundary were often subdivided for potential future suburban development…”,(Ivan McDonald Architects 2004).

“It was beyond the town boundaries that fragmentation of the grid pattern most likely occurred since later surveys had to absorb existing infrastructure as well as topographic features that would become interventions in the grid”, (Ivan McDonald Architects 2004).

The development of Toowoomba is a stark contrast to a place like Canberra, where the whole town is Master Planned to achieve its full potential. Therefore the main factors which influenced the modern Toowoomba, are the early surveyors applying the grid pattern with little regard for the natural features of the land and there being little control over development & subdivision.
The 1957 Survey Plan of Toowoomba at Drayton Swamp can be seen in the appendix B.

1.4 Research Aims and Objectives

1.4.1 Project Aim

To identify intersection treatments that may be used with a high likelihood of success in reducing crash rates, at particular types of intersections in Toowoomba.

1.4.2 Project Objectives

1. Research existing literature from Australia and overseas relating to:
   - Intersection crash frequency and causes;
   - Classification systems for urban intersections used in crash data analysis;
   - Urban intersection crash analysis studies; and
   - Remedial treatments for intersections with high crash rates.

2. Develop and apply a simple intersection classification system which will allow the analysis of intersection crash data by intersection type. Final implementation of the system after consultation with staff from Queensland Transport, Department of Main Roads and Toowoomba City Council.

3. For several categories of intersection, carry out an analysis of the crash data to try and determine if certain types of treatments result in lower crash frequency and/or severity.

2 Background & Literature Review

2.1 Introduction

Any historical resemblance to the modern vehicle intersection crash problem most likely originated back in the early nineteen-hundreds as the motor car (the Model-T Ford) became affordable to the masses, causing significant vehicular traffic. Substantial research throughout the developed world has been done since then to reduce both vehicle crash frequency and severity. Although Australia is one of the safest places to drive, there is still significant room for road safety improvement, (BTE 2000).

The purpose of this literature review is to highlight previous work that is of similar nature to this project both locally & abroad and to provide the reader with background reading necessary for the concepts and reasoning behind the project to be understood.

This literature review also defines the key features of the road transport system and identifies factors pertaining to road safety. An in-depth search was conducted for existing intersection classification systems that are used to group intersections for the purpose of crash analysis. Methods of crash data analysis are examined and utilised in this project where appropriate. Currently available intersection remedial treatments are also explored.

Only intersection or crash information pertaining to this project is explained. For example, the functional classification of roads is explained because the intersection classification system relies on it. Conversely, although the topic of sight distances is very important it may only be skimmed, as it does not have direct use in this project. If the reader requires more information on these topics, the Guides to Traffic Engineering Practice Series by Austroads are an excellent place to start.

2.2 What is a Road Crash?

The terminology itself used to describe a road crash has caused considerable debate among some professionals. The main terms used are "crash", "collision" or "accident", sometimes interchangeably. Ogden (1996) states the use of the word "accident" to describe the failing of road safety is implying that it is due to fate and devoid of predictability. He also states the use of the term "accident" is especially false when the crash was a suicide and the like. On the contrary Hauer (1997) argues 'crash' and 'accident' should be treated as synonyms with regards to road safety, due to the term 'accident' being a common currency with transportation engineers and for statistical relevance.

The term "accident" is very generic and is used commonly in everyday life. It can range from a fall or a spill to a nuclear accident. 'An accident is the chain of events and circumstances leading to unintended injury', (Haddon, Suchman & Klein 1964). In the case of a crash, the outcome of an accident may not be an unintended injury but also/or property damage.

A collision does not always constitute a crash; take for example a car rollover event. BTE (2000) lists other examples of non-collisions that are referred to as crashes:

- Occupant falls in or from a vehicle
- Vehicle exits carriageway unintentionally
- Vehicle breakage
- Person struck whilst boarding a vehicle
- Road infrastructure collapse
- Occupant hit by a vehicles load

Therefore a collision is a more specialised type of crash. The intention is to deliberately use the term '*crash*' in this project.

The definition of a road crash as sourced from Austroads (2004, p.6), states 'a road crash is an apparently unpremeditated event which results in 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)'.

Excluding:

- Crashes on private property or on a public road that has been temporarily closed
- A crash where the vehicle involved was stationary (for example, a pedestrian walks into a parked vehicle) or
- A crash involving deliberate intent (such as murder or suicide).

Austroads (1997) also classifies a road crash fatality, as a crash causing death within 30 days, excluding death from another primary reason or deliberate intent, or a person not directly involved in the crash.

It must first be determined what a road crash is and, what it isn't. Andreassen (1994) stated accidents are sorted according to a set of rules or definitions in order to take a scientific approach to traffic safety, some of which include:

- Runaway parked vehicles
- On carriageway collision between one vehicle and another or an animal, pedestrian or object
- Off carriageway collision possibly after a loss of directional control from the carriageway
- Non-collisions either on or off carriageway
- Other factors, e.g. a fall from a vehicle

(BTE 2000)

With a road defined as 'any highway, or any road or street open to or used by the public', including 'the whole width between abutting property boundaries.' The carriageway being 'that portion of road improved, designed or ordinarily used for vehicular traffic', when a road is divided each portion is deemed a separate carriageway, (Andreassen 1994).

Full definition descriptions and secondary item definitions can be viewed in Technical Manual ATM29 by Andreassen (1994).

2.2.1 Intersection Crash Zone

An intersection (can also be labelled junctions or nodes) is where two or more roads join or intersect. An intersection crash is a crash that occurs within ten metres of that intersection, (Andreassen 1994). Specifically the first vehicle impact occurred at, or within ten metres of an intersection, (DMR 2004).

This definition is not well defined; as the origin of this ten-metre datum point is open to interpretation, such as in the case of the presence of long tapers for auxilary lanes.

2.2.2 Other Essential Definitions

Some necessary additional definitions are shown below:

Crash Exposure - this important element refers to the extent of time exposure to a risk one spends in the risk situation. This is a probabilistic measure of the risk event per unit time of exposure, (Clark 1999).

Crash Frequency - the number of crash occurrences per year.

Hazardous road location or Crash location - 'a location where a limited range of accident-types occurs repeatedly, suggesting that there are common causes, rather than the accidents being the result of mere chance', (Austroads 2004, p.6).

Crash Severity – is the highest injury category or if no injury is sustained, it is the highest damage category from the crash. With "injury severity" simply described as ranging from fatal to uninjured (Austroads 2004).

2.3 Road Safety in Toowoomba

Toowoomba forms part of the National Highway system and has both North-South and East-West Freight movements that go through the city. Most other cities of a similar size have some sort of highway bypass system constructed; so heavy vehicle traffic can effectively bypass the populated centre. This contributes to a sizeable traffic load in Toowoomba during peak times. A bypass for Toowoomba is currently in the planning stage, and has been for quite some time. Mainly due to financial reasons, the bypass will not be in operation for many more years to come. This will put further pressure on road and intersection capacities, which will see an accompanying rise in accidents. Traffic predictions for the existing freight network within Toowoomba and regional routes through Toowoomba are tipped to exceed capacity within 10-15 years, so between 2007 & 2012, (Maunsell 1997).

2.3.1 Statistics & Trends

Suburban and city intersections are the location for a large number of crashes; however they tend to be a lower severity level. In Toowoomba approximately 60% of all crashes occur at intersections, with approximately 24% of these crashes causing hospitalisation or fatality.

There is a certain proportion of multi-vehicle and single vehicle crashes, according to BTE (2000), ATSB nominate an average of 1.6 vehicles per crash from their serious injuries database Australia wide. A more general figure for crashes across all levels of severity of 1.83 vehicles per crash is assumed by BTE (2000).

The general proportion of crashes (accidents) at intersections vs. non-intersection sections related to vehicle distance is shown in the figure below. Crashes are heavily concentrated where intersections and roadside features combined to create traffic hazards for motorists. This graph is from the USA and is quite dated, therefore it is for illustrative purposes only.

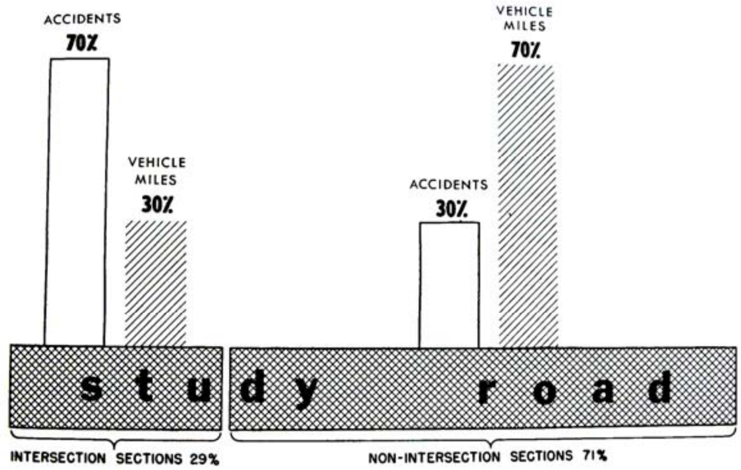


Figure 2-1: Crash Proportions Intersections vs. Non-Intersections

Source: Haddon, Suchman & Klein 1964

In relation to Queensland, (not considering vehicle distance) intersection accidents accounted for 45% of total accidents and 19% of fatal accidents in 2002, (Wadhwa 2006). In comparison for Toowoomba, (from the analysis of the received DMR data) intersection accidents accounted for 57% of total accidents but 38% of fatal accidents in 2005.

In Toowoomba the intersection vs. non-intersection (mid block) crash proportion statistics are as follows:

Table 2-1: Toowoomba Intersection Crash Proportion

		Crashes		
Year/s	Time Period	Total	Intersection	% Intersection
1992 - 2005	14	8490	5391	63
2001 - 2005	5	3502	2104	60
2005	1	771	442	57

Source Data: DMR 2006

Due to a lower number of crashes occurring at intersections as opposed to non-intersections in rural areas, there is a higher proportion of intersection crashes in Toowoomba when compared to the Queensland average. Also note from this basic analysis, intersection crashes appear to be decreasing, meaning more crashes are occurring at mid block locations.

Speaking of human error; the most contentious issue with regard to human modification factors is: alcohol, drugs, fatigue and speed. These are mentioned ahead with regard to the crash data but listed below is some basic facts & statistics relating to them:

- Alcohol & drug driving influence approximately 30% of fatal crashes.
- Fatigue causes around 40 road users death per year. This number is not definite, as it is difficult to identify. Fatigue can affect road users at any time.
- Speed is a magnifier of risk and severity of injury when a crash occurs.
- For young drivers and riders, a major factor in crashes is inexperience.
- In-attention the number one contributor to crashes resulting in serious injuries and increasingly for deaths.

(QT 2003)

The following three graphs put the crash situation in Toowoomba in perspective with other cities in Queensland.

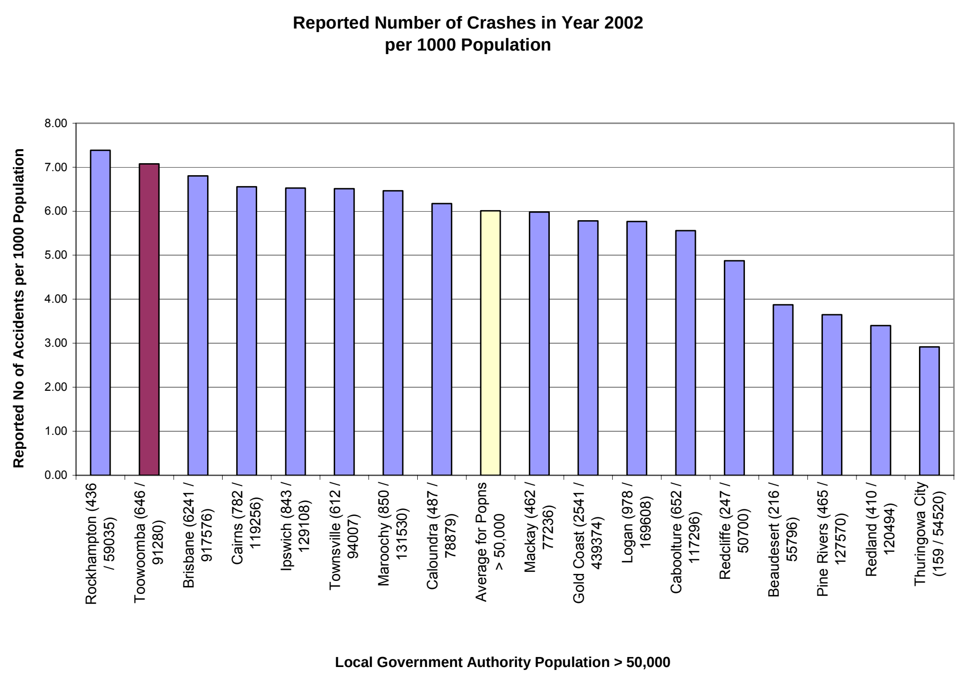


Figure 2-2: Reported Number of Crashes in 2002
Source: TCC 2006

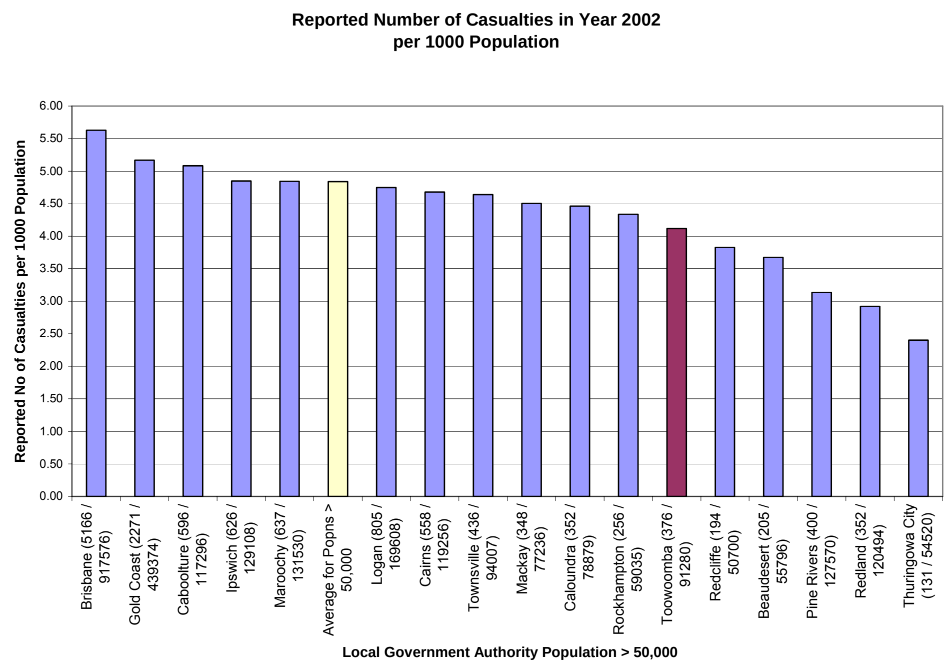


Figure 2-3: Reported Number of Casualties in 2002
Source: TCC 2006

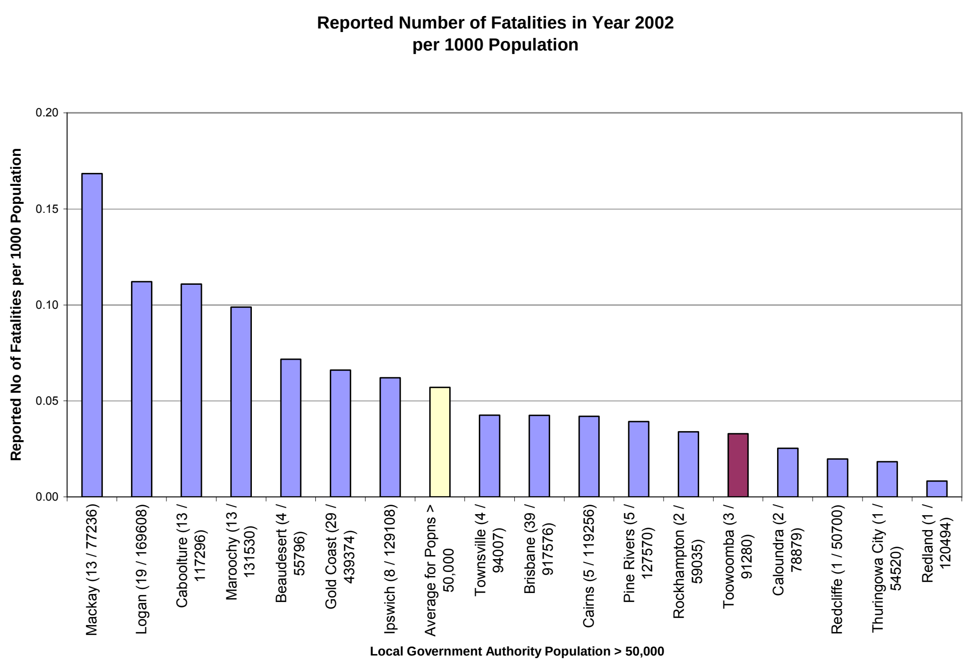


Figure 2-4: Reported Number of Fatalities in 2002
Source: TCC 2006

It can be seen from the above three graphs that in comparison although Toowoomba is quite high in sheer numbers of crashes, the severity is relatively low. This can be characteristic of slow & hostile traffic flows likely from congestion, where there are many minor vehicle impacts without the speeds to cause serious injury.

It is widely recognised an increase in motor vehicle crashes is likely due to the increase in motor vehicles on the road. However, there are also opposing trends, which lower crash frequency and severity due to technology improvements in cars and road infrastructure, etc. The graph below although well out of date, illustrates this trend that continues today.

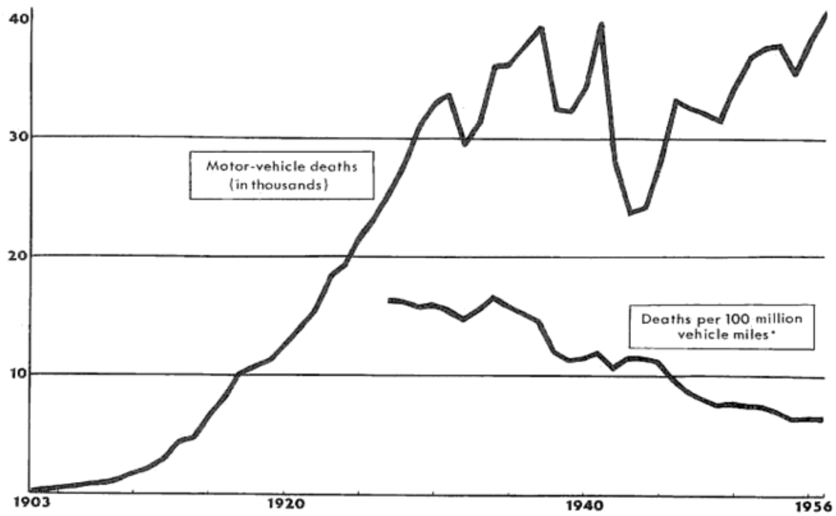
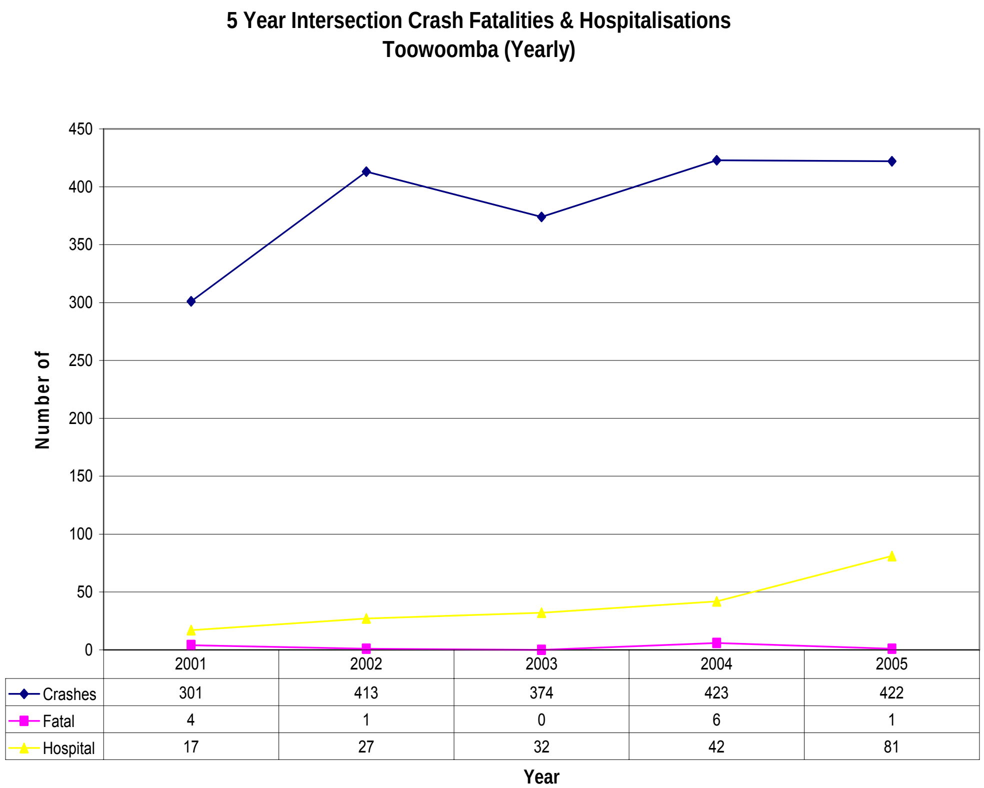


Figure 2-5: USA Vehicle Deaths annually & Mileage Rates
Source: Haddon, Suchman & Klein 1964

To give an idea of the Toowoomba situation, overleaf is a five-year graph of the number of fatalities and hospitalisations for intersection crashes only. It can be seen in 2004 that the number of fatalities was high and that hospitalisations have increased significantly since then; traffic volume information was not available for comparison.



	2001	2002	2003	2004	2005
Crashes	301	413	374	423	422
Fatal	4	1	0	6	1
Hospital	17	27	32	42	81

Figure 2-6: 5 Year Intersection Crash Fatalities & Hospitalisations – Toowoomba
Source Data: DMR 2006

Unless public transport in Toowoomba improves somewhat, the future traffic volume projections are going to continue growing. 'The use of cars in SEQ is growing faster than the population: there are far more cars, being used more often and driven further than ever before. It is acknowledged that private cars will continue to be used into the future for the majority of trips in SEQ', (QT 2005).

Figure 2-7 shows the growth trends for South East Queensland's population and vehicle kilometres until 2026.

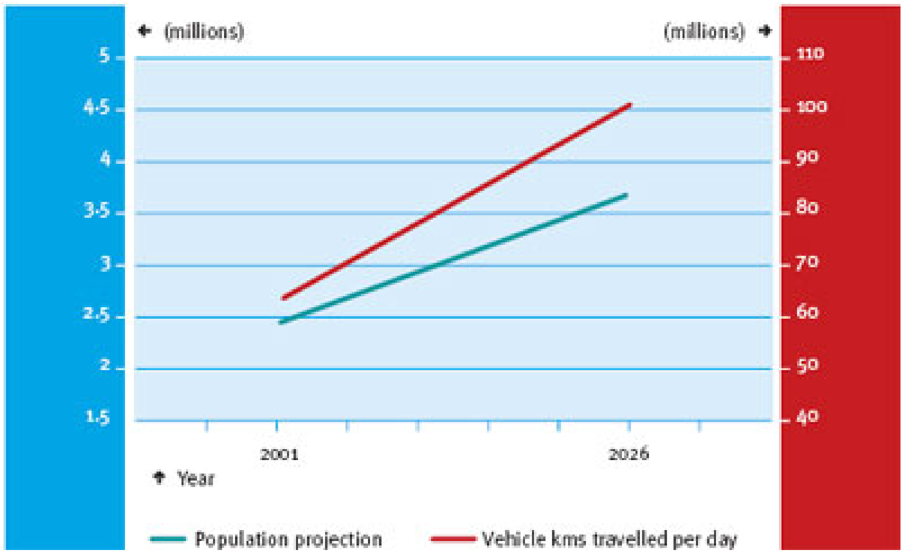


Figure 2-7: SEQ population & vehicle km travelled per day to 2026

Source: QT 2005

For further Queensland statistics refer to the Queensland Transport website for their regular Road Traffic Crash (RTC) reports. QT has been the official source of road traffic crash statistics since 1991, (QT 2005). For Toowoomba specific statistics, the Toowoomba City Council should be able to provide that.

2.4 Accident Causation Factors

There are many accident causation factors ranging from simple human mistakes to bridge collapse for example. Road traffic may be considered as a system in which various road crash components interact, with the main three components being:

- The human
- The vehicle &
- The road

(Austroads 2004)

The following figure represents the interaction of these components. The percentage proportions can vary from one situation to another. While human factors are involved in the majority of accidents it is often more effective to apply road safety engineering treatments to the road environment.

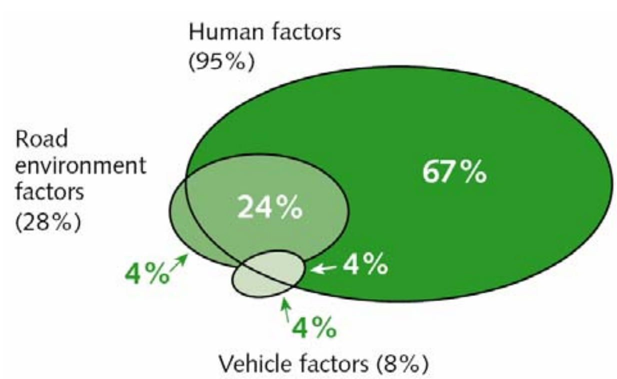


Figure 2-8: Road Crash Components

Source: Austroads 2004

Looking at road environment crash causation factors alone creates too large a list to investigate, only the factor section names are outlined below. The reader is directed to Austroads (2004, p. 62) for the full checklist of possible crash contributing factors.

- Road , road surface & road geometry
- Intersection

- Signs & markings
- Traffic signals
- Pedestrian & Cyclists
- Lighting
- Parked vehicles
- Speed & the environment
- Roadside
- Visibility
- Evidence of problems

As you can see all the above factors relate to the physical road infrastructure and surrounding environment only. For the human component the reader is directed toward the ARRB publication, *Road user behaviours which contribute to accidents at urban arterial/local intersections* by Cairney & Catchpole (1991). This provides an extensive study into road user behaviours with the approach of modifying the road transport system.

The component that a road safety engineer has the least control over is, vehicle factors. This component is mainly controlled by market forces, product liability and legislation such as the Australian design rules, (Clark 1999). Also adding good vehicle maintenance with special regard paid to suspension and tyre conditions. For more information, a starting point is Clark (1999, p. 57).

2.5 Past Toowoomba Studies

Limited studies were found that directly related to the whole of Toowoomba City with regard to intersections crashes, and no studies related to the dedicated classification of intersections. The reader is directed towards the below publications if they are requiring any research study reading.

Some past research projects for the Toowoomba area conducted by students relating to this project include:

- Jensen 2004, *Influence of physical road characteristics on road crashes*
- McGuire 1996, *Traffic Accident Analysis for Toowoomba City*
- Pumliab 2000, *Modelling of Traffic Flow in Toowoomba CBD using an EMME/2 Model*
- Pomerenke 1997, *Risk Assessment of the Movement by Road of Dangerous Goods through Toowoomba*
- Finegan 1999, *Prioritisation of Remedial Safety Works on Rural, At-Grade Intersections*

Some relevant professional studies include:

- Queensland Transport & Toowoomba City Council 1991, *Toowoomba Road Network Review*
- DJA Maunsell for Toowoomba City Council 1996, *Toowoomba Metropolitan Transport Network Study (TMTNS)* - Final Report
- Ove Arup and Partners, Carisgold Pty Ltd and Buckley Vann Town Planning for Queensland Transport 1995, *Toowoomba Transport and Traffic Planning Study (TTTPS)* - Final Report
- Davidson for Queensland Transport 1994, *Toowoomba regional transport network study (TRTNS)*

2.6 Hierarchy of Roads

The hierarchy is a classification system for roads that ranks them according to their character of service provided. Its assignment can vary between authorities managing the road network. The hierarchy of roads or streets is determined by the functional classification assigned to them.

Table 2-2 displays the comparison between different hierarchy definitions by various authorities in QLD and Australia.

Table 2-2: Road hierarchy Comparison

Functional Hierarchy	Queensland Main Roads	Queensland Streets	A.R.R.B	AUSTROADS
Highway	State Strategic Road and National Highway	Freeway	Arterial	Freeway
Arterial	Regional Road	Major Arterial	Sub Arterial	Primary (other Arterial)
Distributor	District Road	Arterial	Distributor	Secondary Arterial
		Sub-Arterial		
Trunk Collector	Not Covered	Trunk Collector	Collector	Distributor
Collector		Residential Collector	Local	Collector
Access Street		Access Street		Local

Source: Austroads 2004

The functional classification of urban roads is detailed in DMR (2003) appendix A, classifying a road as part of a road hierarchy plan. DMR table A1 describes the classification and functional description, which outlines the access versus mobility and typical intersection spacings for the arterial roads. Also shown, is the maximum traffic volume per day, for each classification. DMR table B1 of appendix B is the hierarchy of typical speed limits of urban roads. Listed is speed limits 10km/h to 100km/h (in 10km/h steps) with the general application of each increment (DMR 2003).

DMR (2003) places great emphasis on the functional classification of urban roads, linking the relationship between classification, access versus mobility, traffic flow, intersection spacing, application or purpose and speed limits for each.

DMR (2004) is the primary technical reference for DMR with new and upgraded roads. Chapter 1 describes the road hierarchy and function as it applies to Australia. The elements that combine to form the road network have broadly two types of traffic movements, “access” or “circulation” traffic and “through” or “bypass” traffic (DMR 2004, p.1-7). A superior road network design would allow the two traffic types to operate effectively and efficiently to reduce the mixing of incompatible functions., If mixing occurs conflicts can happen which can degrade the main objectives of each type, being access and mobility. ‘When traffic volumes are low, the dual function can be accepted; as traffic volumes increase, the problems associated with this duality of operation become very important. This can lead to breakdowns in the service provided in both functions as manifested by delays, accidents, and other malfunctions of the network', (DMR 2004, p.13-5).

All major arterial roads travelling through Toowoomba have intersections; this goes against the generalisation made by "Queensland Streets" that no intersections should be present (IPWEA 1993). By not having grade separation in Toowoomba for these major arterial roads, mixing of incompatible functions can occur and undesirable intersections are formed, as seen in the figure below.

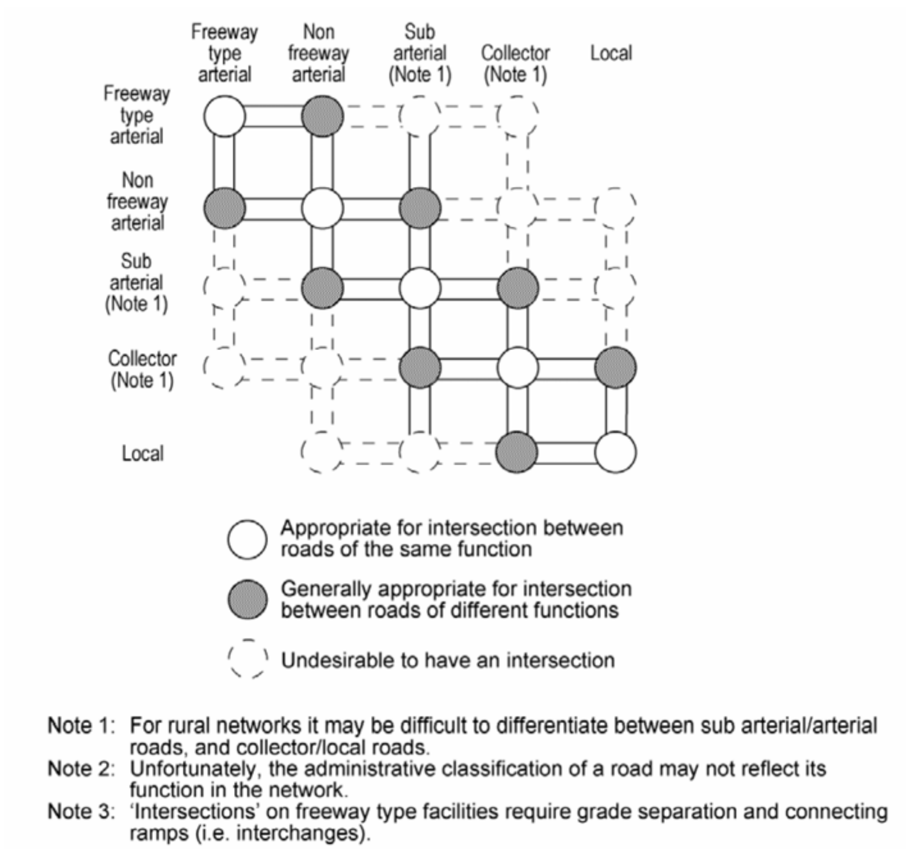


Figure 2-9: Compatibility of Intersections at Grade

Source: DMR 2005

For example Toowoomba may have non-freeway type arterial roads intersecting with local roads, more often than other similar sized cities that also have a national highway passing through town.

Loss of safety and amenity to residents can occur when “through” traffic does not get fully excluded from the residential street system. This permeation of “through” traffic is known as “short cutting” or “rat-running”, as the non-residential traffic tries to save time and/or minimise distance (IPWEA 1993).

Of course this hierarchical classification is theoretical and just because a road is nominated as a particular class does not mean it will operate as so. For a road operating out of its classification the appropriate measures must be taken by authorities for it to operate correctly, (QT 1991).

Toowoomba’s road hierarchical structure is created in conjunction with town planning and development. TCC publish their road hierarchy in graphical form with their Toowoomba planning scheme 2003 - Regulatory Maps, the key of which is shown in the figure below. The maps can be downloaded from <http://www.toowoomba.qld.gov.au/>, under Downloads Home » Publications » Planning » Documentations » Maps – Regulatory.

Figure 2-10: TCC Road Hierarchy

Source: http://toowoomba.qld.gov.au

As mentioned previously, most of the city is based on the grid street pattern with a somewhat fragmented road hierarchy, which came from years of sub-dividing subdivisions. High connectivity is provided, but this can cause the mixing of different traffic purposes, e.g. local residential vs. commercial traffic.

2.7 Accident Type Classifications

Crashes (or accidents) are always classified by type to define the nature of the crash for further analysis and comparison to determine crash countermeasures.

There are three broad classes of road traffic accident types as recommended by the World Health Organisation (WHO) Geneva 1977.

1. Motor vehicle/road accident
2. Non motor vehicle/road accident
3. Railway train/road accident

(Andreassen 1994)

Each of the broad classes further subdivides into more specific accident types, which can be seen in Technical Manual ATM 29, Andreassen (1994). This disaggregation of accident types leads into the system of known as Definition of Coding of Accidents (DCA). This system is currently used in Australia and is the standard for the Austroads Association and DMR.

However Toowoomba City Council maintains its own crash database using a slightly different coding system for crash type coding which is based on an older version of Road User Movement "RUM Codes". These original codes were introduced in Victoria in 1968 (Austroads 2004), and later refined. The TCC RUM Code in use only specifies two digits for each code. For example, a DCA code "202" is the equivalent to a "21" RUM Code. The TCC RUM codes also are without five crash codes but include an extra one labelled "unknown". This RUM coding chart is attached in Appendix C.

There are many other accident classification systems in use throughout the world but they all essentially achieve a concise summary of the crash type. Systems also slightly vary depending on the side of the road vehicles drive on. Hutchinson (1987) compares several crash coding systems from around the world (some may have been revised now).

The standard table for Australian DCA codes is shown in the following
Figure 2-11, which was taken from Austroads (2004). These codes are used in this dissertation and will be referred to throughout. Looking at Figure 2-11, the crash type uses the columns of the coding system first which are based on the traffic movements leading up to the conflict situation which results in the accident. Subsequently the rows of the coding system are used and relate to driver or all pedestrian intent as well as actual movement, (Andreassen 1994).

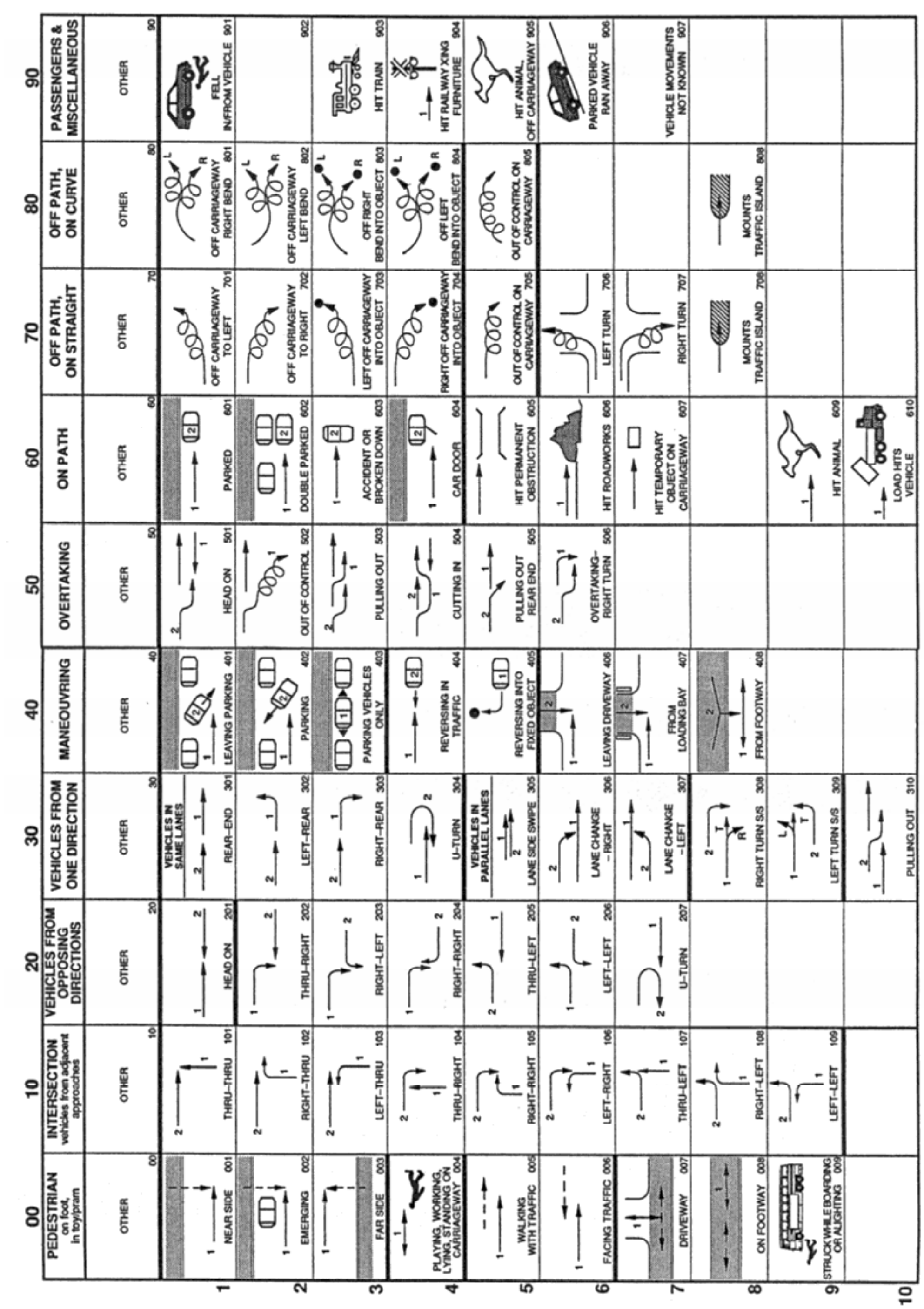


Figure 2-11: Australian DCA Codes
Source: Austroads 2004

'During the coding of information from the accident report form, each accident is given a DCA-code indicating the movements the involved road users were making when the collision occurred. For example, the accident involved a right turning vehicle collided with an oncoming vehicle, it would be given a code of 202', (Austroads 2004, p. 32). The corresponding DCA code extract is shown below:

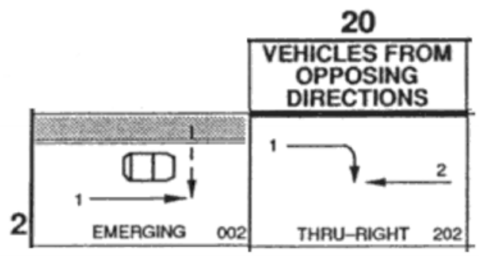


Figure 2-12: DCA 202

Source: Austroads 2004

Some DCA key points to note are:

- Severity classification is only to be used within accident types
- It is possible for the one accident to have crash events
- If a time lapse occurs between multiple accident events, they may be considered as two separate accidents.
- However most coding systems use a single code event to describe an accident and some use the initial event for coding with there no priority protocol for this.

For the full explanation on the method of coding accidents with decision trees the reader is directed towards Andreassen (1994).

2.8 Existing Intersection Classifications

A comprehensive search was conducted to find existing intersection classification systems, interestingly only basic classifications existed and little was mentioned about relating the classifications to crash data analysis. Many minor systems were found, but only the unique and main ones will be mentioned here.

ITE (2004) outlines their recommended process for identifying and reviewing problem intersections. The first step is to filter the data to normalise the comparison by:

1. Signalised / Unsignalised
2. Urban / Rural
3. Functional Classification

Without actually stating it, ITE (2004) are classifying intersections by these criteria before data analysis is conducted.

Roy & Lindeberg (2004) documented a signalised intersection classification as follows:

Permissive from a shared lane -	Permissive without turn lane
Permissive from an exclusive left turn lane -	Permissive with turn lane
Protected/permissive from exclusive left turn lane -	Protected/permissive
Protected from an exclusive left turn lane -	Protected
Dual left turn lane with protected phasing -	Dual left turn lane

1. PNTL 2. PWTL 3. PP 4. P 5. PD

With further classification by:
low volume - high speed
high volume - high speed
low volume - low speed
high volume - low speed

Another dedicated signalised intersection classification very similar to above by Yu, Fengxiang, Zhang & Tian (2004) is shown below:

PT – Protected; PM – Protected/Permissive; L – Low Speed; H – High Speed;
1 – One Left-turn Lane; 2 – More Than One Left-turn Lanes

Which produces a single classification code like: L2PT or H1PM, etc.

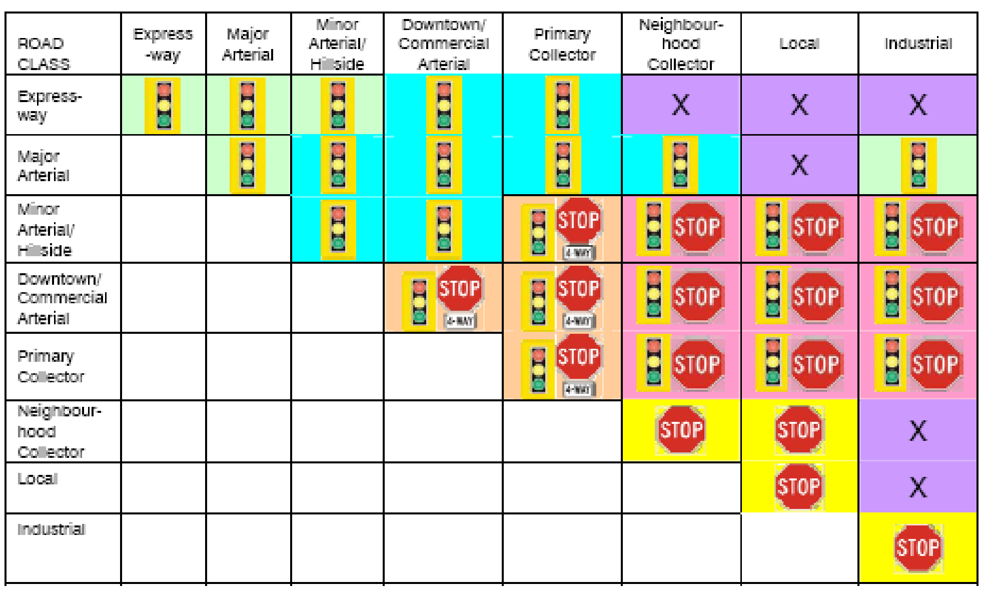
Morocoima-Black, Chavarría & Kang (2003) offer a very simply intersection classification system based on traffic volume, where intersections are classified according to the volume of entering traffic, combining signalized and unsignalised intersections.

- Class A: 20,000 daily vehicles or greater
- Class B: 10,000 to 19,999 daily vehicles
- Class C: 5,000 to 9,999 daily vehicles
- Class D: 2,000 to 4,999 daily vehicles
- Class E: 1,999 or less daily vehicles

In the intersection safety study by Pernia, John Lu & Brett (1999), intersections were simply classified by stop control as shown below:

1. AWSC = All Way Stop Control
2. TWSC = Two Way Stop Control
3. Signalised

However several other classification systems were discovered, with all based on road hierarchy. The best system is shown below; it also has the addition of signal type built in.



INTERSECTION CLASS	TYPICAL CONTROL	
Major (M)	Signal	
Primarily Major (PM)	Signal	
Mixed	2-way STOP/Pedestrian Signal/Semi-Actuated Signal	STOP
Primarily Local (PL)	4-way STOP/Possible signal	STOP
Local (A)	2-way STOP/YIELD	STOP
Incompatible Road Functions	Varies	X

Figure 2-13: Major Categories of Intersection Classification by Road Classification
Source: Rocchi (2003)

This classification system was the best existing one found that could be adapted the suit Toowoomba. The Rocchi (2003) report also outlined recommended design guidelines for each class of intersection.

2.9 Crash Data Analysis Methods

The main reference materials used in this project for the data analysis were *Model Guidelines for Road Accident Data and Accident Types by* Andreassen (1994), *Safer Roads: A Guide to Road Safety Engineering by* Ogden (1996) and *Guide to Traffic Engineering Practice Series Part 4, Treatment of Crash Locations* by Austroads (2004). The latter has substantial content derived from the former two books and is the standard manual used by DMR, therefore is the recommended platform for further information.

Austroads (2004, p. 37) sets out a methodical step-by-step process to treat the location of Crashes. The following are the steps and basic descriptions for this project; refer to Figure 2-14 for the full flow chart:

1. Decide on the criteria for listing crash locations
    a. Define physical limits
    b. Decide on the time period of data
2. List all crash locations to investigate

3. Obtain all relevant information
    a. Crash data
    b. Traffic volumes
    c. Infrastructure upgrades
4. Diagnose the problem (Analysis)
5. Select countermeasures
    a. Concentrate on accident types
    b. Choose by judgement, experience, and known options

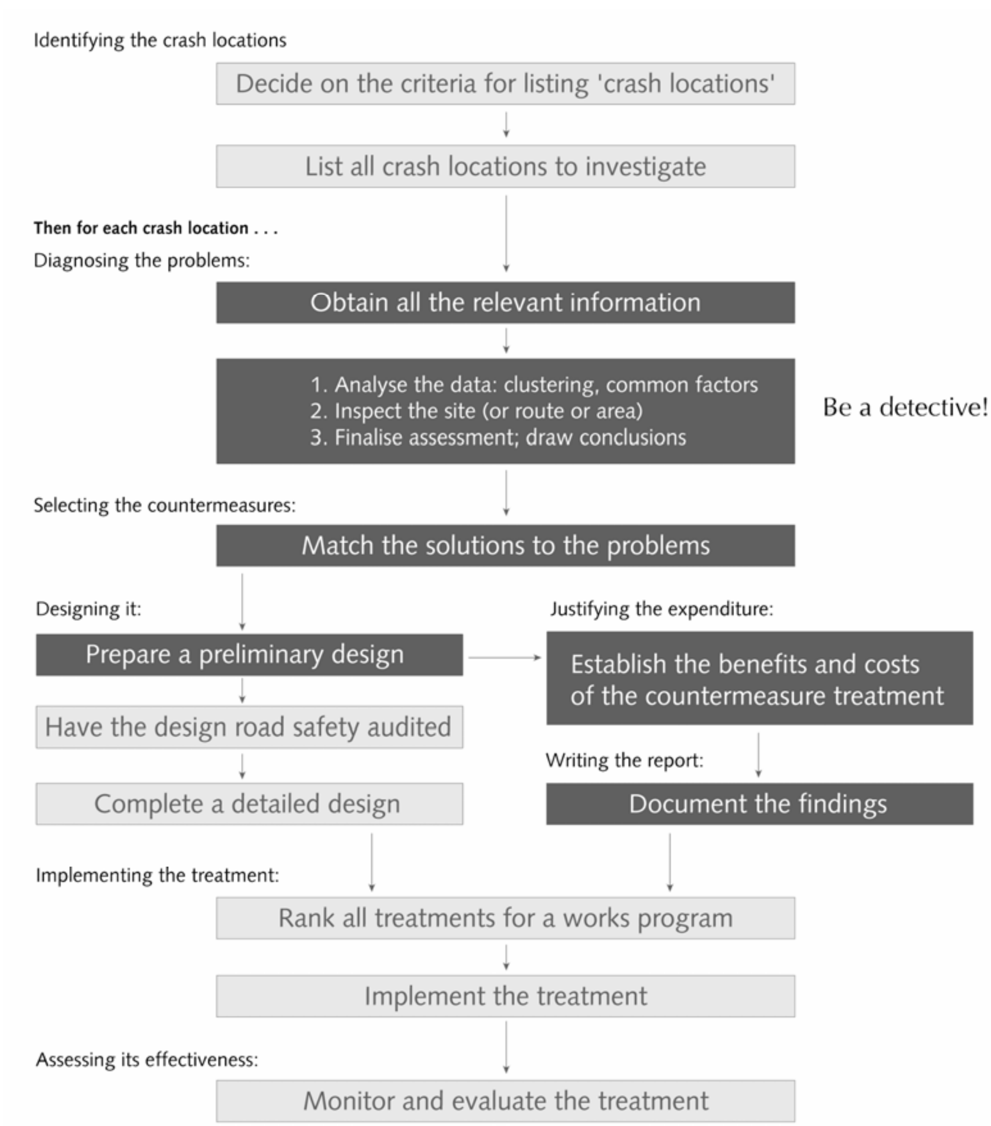


Figure 2-14: Treatment of Crash Locations Steps
Source: Austroads 2004

As stated in the previous section ITE (2004, p. 33) outline their process for identifying and reviewing problem intersections, with the main steps as follows:

1. Filter data (see last section)
2. Compare intersection data with other area data
    a. Features, figures & causes
3. Review temporal trends
    a. By years, months, days, weeks, hours
4. Review crash patterns with respect to intersection attributes
    a. Traffic control parameters & operations
    b. Intersection design
5. Field review

Austroads (2004) process for diagnosing the crash problems with regards to analysing the data outlines the use of clustering for common factors, which includes using a factor matrix, collision diagrams and frequency histograms of DCA sub-groups.

'Dominant DCA types often provide the most reliable guide to the remedial action, since they are likely to be indicative of the future crash patterns at the site, if it is not treated', (Austroads 2004, p. 51).

Ogden (1996) lists six steps in the diagnosis phase:

1. Study detailed accident reports
2. Determine groups of accident types in a location by sorting data into a accident factor grid
3. Data amplification by detailed on-site investigation
4. Detailed data analysis
5. Identify dominant road features & factors
6. Determine the nature of the accident problem

The general data analysis methodology for the Toowoomba Road Network Review in 1991, aimed at standardising accidents by:

1. Applying a severity rating to each crash

2. Determining an exposure value based on traffic counts
3. Determining a risk value or crash rate

(QT 1991)

This analysis identified intersections that required further analysis.

2.9.1 Identifying Hazardous Locations

Identifying hazardous road locations (HRL) is an important and often sensitive part of a crash investigation. HRL identification is also often extended further into an investigation to weigh up the cost vs. benefits distribution. Road authorities have limited resources to put into remedial works, so identification where to most effectively allocate those resources (mainly funds) is essential. The worst intersections must be identified by some criteria and must be able to be treated in an efficient and effective manner, although it is often not just an engineering issue but a social and political issue also.

Some of the main criteria for selecting locations to investigate for treatment are as follows:

- Crash cost by "accident type" (by DCA code)
- Number of crashes for a period of time
- Rate of crashes for a period of time
- Number or rate exceeding a threshold value
- Difference between observed and expected crash numbers

(Austroads 2004)

Although other methods exist, the recommended one for identifying hazardous intersections is written by Austroads (2004) and BTE (2000) which compares locations using the cost of crashes by "accident type". Documented standard crash costs exist for different areas, with varying values for property damage and severities of casualty costs. Austroads (2004) table 11.1 gives an example of this for Queensland current as of 1996. The figure below also gives an idea of the components that make up the total cost also from 1996.

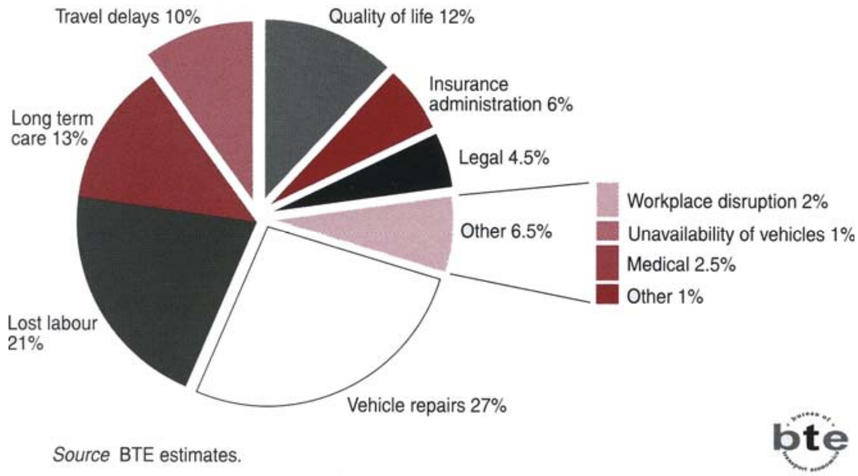


Figure 2-15: Cost of Road Crashes by Cost Category, 1996
Source: BTE 2000

Ogden (1996), states that Crash Frequency alone is the most widely used identifier for hazardous intersections. This project adopts Toowoomba City Councils' top 100 worst intersections for analysis to narrow the scope and not to repeat the task when it is not central to this projects aim. Further discussion about the TCC top100 is presented in chapter 5.

2.10 Documented Remedial Methods

Remedial methods or treatments (also known as counter measures) can be applied to most causation factors in an accident with varying levels of success and cost. As seen previously in figure 2-8, Road Crash Components, road & environmental factors only account for 28% of road crash causes. Applying remedial treatments to intersections therefore needs to also influence some human factors to maximise success. Figure 2-16 displays a haddon style matrix with some basic causes and roles of people, vehicles and the traffic environment. The improvement of these roles is the basis of a countermeasure.

With reference to the figure below, active safety concentrates on the avoidance of a crash, whilst passive safety relates to protection & care offered during and after the crash, (Clark 1999).

Safety Viewpoints			**Roles of Vehicles, People, and Traffic Environment**	
	Steps	**Causes**	**Roles**	
ACTIVE	Safe Driving	**Human error** * Inattention * Excessive speed * Following too close * drug/alcohol	**Vehicles:**	Basic performance, legible instruments, and visibility
			People:	Keep safe driving in mind, Appropriate operation.
			Environment:	Improve traffic environment, Offer traffic information
	Preventative Safety	**Inappropriate driver reactions**	**Vehicles:**	Easy to drive, Minimise fatigue and stress
			People:	Appropriate tension, Maintain concentration
			Environment:	Improve road environment.
	Avoiding Accidents		**Vehicles:**	Improved performance for avoiding accidents.
			People:	Training for appropriate response, Driving experience.
			Environment:	Improve road surface and roadside facilities.
	ACCIDENT	OCCURS		
PASSIVE	Minimise Collision Damage	Incorrect use of safety equipment such as seat-belts	**Vehicles:**	Cabin integrity, Passenger protection system
			People:	Proper seating posture, Wear seat-belt
			Environment:	Impact-absorbing road facilities
	Minimises Post-Collision Damage	Impact with interior	**Vehicles:**	Facilitating rescue, Fire prevention
			People:	Physical strength
			Environment:	Improve emergency medical system

Figure 2-16: Safety Viewpoints

Source: Clark 1999

Research into standard remedial treatments has been conducted for many years. A good example of research into the effects of roadside features on traffic crashes is shown in figure 2-17. All data regarding road and roadside features and crash occurrence were recorded on a detailed strip map for study. The effects of various roadside features on traffic crashes were determined.

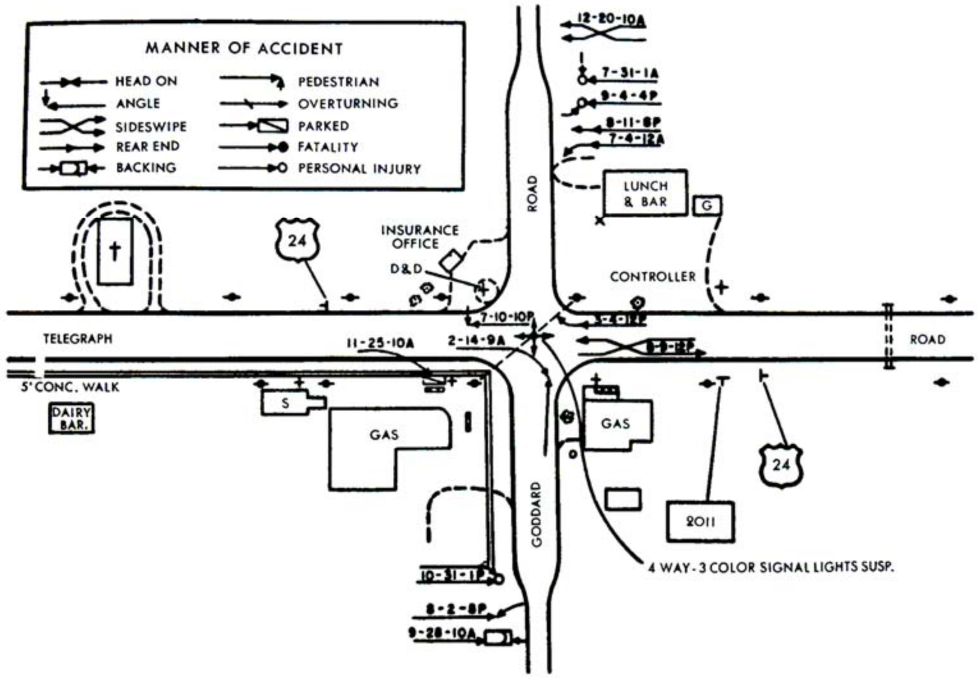


Figure 2-17: Effect of Roadside features on Traffic Crashes

Source: Haddon, Suchman & Klein 1964

Further study of remedial treatments that work effectively for particular problems were developed into tables of options for remedial works, these are usually based on DCA codes.

The selection of countermeasures is documented in Austroads (2004, p.73). It includes the full process to select the correct countermeasure for the situation with estimated the reduction in crashes to be expected and the casualty costing. Ogden (1996) also has comprehensive tables for countermeasures, all of which are based on intersection type and DCA code to treat.

A very important point to note is, in adopting a remedial treatment it will only reduce crash frequency or severity, not both. Another potential problem is the remedial treatment applied may create new problems which were previously not present.

A common major intersection treatment is the installation of a roundabout; these improve safety by forcing a reduction in speed or moderating traffic flow. A roundabout need not be perfectly round either; various parts of its geometry can be adjusted to design for the application. However roundabouts are not suited to all intersections, the main advantages of them vs. traffic control signals are listed below:

Roundabout

- Decreased delays & queue lengths
- Crash severity reduced
- Maintenance cost negligible

Traffic Signals

- Need positive control for pedestrians
- Roundabouts unsuitable for:
    - Large numbers of cyclists
    - Unfavourable topography
    - Construction & lighting requirements difficult
    - Limited space

    Clark (1999)

An important tool worth mentioning is Simulation Intersection Modelling - SIDRA Solutions by Akcelik & Associates Pty Ltd. This software can be used to design & model the operation of an intersection in the design phase before construction. It can also be useful in the design of remedial treatments of an existing intersection. The model can be calibrated to the existing geometry, traffic volumes and characteristics, which can then allow for virtual intersection changes where the effects can be observed in the software.

The design and application of remedial treatments is not an easy task to perfect. Clark (1999, p. 37) has compiled a list of barriers to countermeasures that are abbreviated below:

1. Each crash is unique, implies that we can learn nothing from the previous crash to help avoid future crashes.

2. Blaming the “at fault” driver suggests they are the core problem, which may redirect attention away from the true cause.
3. Simply using the term “accident” implies that it is a random act that we can do little about.
4. Crash statistics are so common place now they are almost unnoticed.
5. Many solutions may be seen as too expensive.
6. Improving the safety of vehicles may be resisted because of the costs involved, may not necessarily help sell the vehicle.
7. The lack of effective pressure groups.
8. Believing that great driving skill alone is critical to road safety, despite evidence to the contrary.

There is no guarantee that any documented remedial treatment will be as effective as the designer hopes. The main unpredictable factors that block the engineering solutions from being successful are human factors. For example, inexperienced or elderly drivers, or impairment through alcohol/drugs or fatigue, etc. are major factors. Risk perception is another key factor, such as optimism bias and risk homeostasis, (Clark 1999).

Optimism bias refers to our optimistic nature. People see themselves as less likely to suffer any and negative consequences, and that someone else may. This can form a barrier to avoidance motivations, which help us be cautious.

In addition, risk homeostasis is the idea that a driver will adjust the same risk level regardless of the contribution to risk from the surrounding environment. For example, no net safety benefit is achieved, as people tend to drive faster on safer roads, (Clark 1999).

Some human motivation factors play a part also, such as avoidance and aggression. Therefore, the most effective intersection remedial treatment will be those which make it safer but appear to make the intersection less safe, thus causing a slowing of traffic and extra cautious driving behaviour. However, this approach is not usually put into practice because of negative perceptions causing political pressures, (Clark 1999).

3 Crash Data

3.1 Introduction

This chapter is dedicated to the sourcing, use and limitations of traffic crash data. With the common availability of personal computers and mainframes, crash data is efficiently captured managed & analysed throughout Australia. This is done by various government agencies and some public companies including:

- Road safety engineers
- Police & Lawyers
- Insurance companies
- Publicises & Educators
- Researches
- Vehicle & component manufactures

Austroads (2004)

However data often only originates from a few sources such as the police, hospitals, insurance companies and some road authorities.

- Police have become the default crash data collector for many other agencies, mainly because they are first on the scene, work 24 hour shifts and ultimately serve the people, thus giving up their data freely. The police use the data themselves as a way of gauging their progress of improving road safety.

- Accident & Emergency departments of hospitals collect data for accounting, out-patient and medical purposes. This data is not normally used for road crash analysis (Giles 2000).

- Insurance Companies assemble crash information from their client's claims. They use this data for risk assessment, premium setting and compensation payments. They also rely on police information to validate crash occurrences and details (Vincent 1998).

- In Toowoomba, DMR & TCC obtain the bulk of their crash data from the Queensland Police. In the case of a fatal accident on a Main Road, DMR usually attend that crash scene to gather detailed information that the police often do not collect. Particularly information pertaining to the influence the intersection may have had on the crash.

BTE (2000) states using insurance company data yields more crash data than any other organisation. However the following issues skew the insurance data by underestimating minor crashes, through non-reporting.

- Crashed vehicles that are not comprehensively insured usually are not reported
- The insurance excess is high compared to the vehicle damage
- The loss of a no-claim bonus is an issue

3.2 Project Data sources

Not all data collection agencies usually give their crash data away freely. The following sections talk about the source of the crash data used in this project. DMR and TCC are the data providers, which are both willing to give the data for free and have most of the necessary engineering content. However, the Queensland Police force are the original authors of the majority of this data, so how they collect it must be understood.

Authorities collecting crash data, obviously gather only what data they need. However for road authorities there are minimum recommended dataset lists available. Use is not mandatory, but encouraged so that the sharing of data can take place for observing crash trends and conducting research. There are different sources of dataset recommendations, but the main document to use is, Austroads (1997), *A Minimum Common Dataset for the Reporting of Crashes on Australian Roads.*

This project only uses what is given by the road authorities in Toowoomba. The following pages, contain further explanations of the data received.

3.2.1 Police Road Crash Data

The Queensland Police Service collects road crash data from the scene on a Traffic Accident Report form.

What is a Reportable Accident?
From December 1 1999, the reporting criteria for all States and Territories became:

- A vehicle requires towing away,
- Any driver involved in a crash fails to provide his/her details,
- Any person involved is killed or injured; or
- If the crash causes damage to property $2,500 or greater (other than the driver's vehicle)

(QT 2000)

The above criterion creates some fundamental limitations of the police data such as:

- If crashes that do not meet the criteria, the Police do not have to nor usually want to report them.
- ‘Bias in the Police databases (either the pre- or post-December 1999 databases) is thus towards the more serious 'accidents'. It is also possible that crashes falling inside the legislative requirement remain unreported due to ignorance of the law or resolute non-compliance by particular drivers’, (Giles 2000).
- Giles (2000) also states only 54% of crashes for which vehicle insurance damage claims is made are reported to the Police.

Despite the risks for Police under reporting, the data they generate is the most popular for use in crash data analysis and is known to be of high integrity. Most government agencies receive their crash data from this source.

3.2.2 Road Authorities

The Data used in this project originated from two sources Toowoomba City Council and the Queensland Department of Main Roads. However the original authors of the majority of the crash data are the Police. They provide crash data to these two authorities in different ways.

The Toowoomba City Council (TCC) provided their crash data for use in this project on the 16th of June 2006; in the form they had it being Microsoft Excel. TCC have a fairly unique relationship with the Toowoomba Police, in that TCC receive the crash data via a copy of the original first page of the Police Report. It is said no other Local Government Authority (LGA) in Queensland receives data in this way. This first page of the Police report has the main crash information, but not everything. At some stage the data is entered into a computer, where TCC use it for basic monitoring and analysis.

Appendix C contains a sample of the data received from TCC, the list below describes the full contents:

- Sample crash data C1-C2

- Top 100 hundred TCC intersection ranking containing:
    - Intersection treatment dates
    - Annual crash data
    - Traffic volume data C3-C6

- All of Toowoomba Crash risk charts C7-C9

- TCC Road User Movement codes (RUM) C10

The focal crash data used in this investigation was sourced from the Queensland Department of Main Roads on the 15th of May 2006. It was exported out of the software package ‘Road Crash 2’ and into Microsoft Excel, for bulk data analysis. Appendix D gives a sample of the DMR data received (D1-D5) with the main table of descriptive codes (D6). The main reason this data was more important to this project is that it has many more fields of information.

The flow of data from the police database is as follows. The data is transferred weekly into the corporate Web Crash 2 database administered by the Queensland Department of Transport (QT). 'Road Crash data is collated and stored by the Department of Transport for all reported road crashes in Queensland, including those on both the State-controlled road network and local government roads. The data is stored in the Department's Road Crash System', (Road Crash 2 Software Help).

From the QT database, district data can be accessed by the relevant district via the Road Crash 2 System (RC2). A pictorial representation of the total Road Crash System is shown in the figure below. The arrows symbolise the direction in which data is flowing within the system.

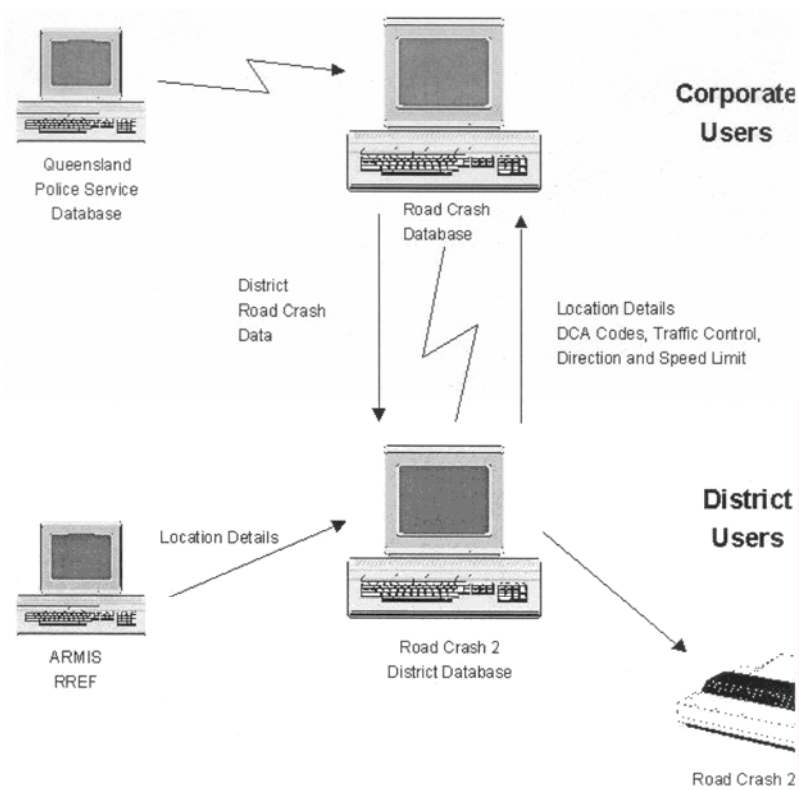


Figure 3-1: Total Road Crash System
Source: Road Crash 2 Software Help

Some capabilities of what the Road Crash 2 system can do for district users are as follows:

- Crash details report generation specific to query
- Crash data graphs
- Collision diagrams
- Benefit cost ratio calculation
- Crash rates for road segments or intersections calculation

(Road Crash 2 Software Help)

It can also be seen from the Total Road Crash System diagram, that data can flow both ways between the QT Road Crash database and the Road Crash 2 district database. This enables district users to modify or add road crash details.

Another useful Main Roads database used in road crash investigation is ARMIS, which stands for A Road Management Information System. The ARMIS database is administered and maintained by DMR. "ARMIS is the Main Roads' authoritative source of road asset data, and is an information system consisting of integrated databases (road reference, inventory, road condition, traffic, bridge information, road accidents and others), a data warehouse (Roads Information Data Centre) and tools for data capture, query and presentation", (Robertson 2005).

Combing the ARMIS spatial data with the crash data base enables the crash data to be presented in a Geographic Information System (GIS) such as MapInfo Professional (as used by DMR). MapInfo Professional is a powerful mapping application that enables visualisation between data and geography, greatly increasing the ability to perform sophisticated and detailed data analysis of the crash data. Patterns and trends in the crash data that may otherwise have been missed in spreadsheets and charts could become visible. The GIS system significantly enhances decision making abilities in crash data investigations.

3.3 Traffic Volume Data

Traffic volume data is an important parameter which is linked to the amount of crashes that could occur on the road transport system. Theoretically doubling the traffic volume on a section of road could double the crashes, but it can be much more complicated than that. Therefore during crash data analysis, there are occasions when the crash data must be corrected for traffic volumes.

Traffic volume data can be acquired in several ways as seen below, different methods could be either permanent or temporary:

1. Pneumatic road tube counters
2. Inductive loop counters
3. Manual counts (by people)
4. Camera Systems

Devices 1 and 2 above are most suitable for road/street traffic volume counts, where the data is commonly employed in pavement design. Intersection traffic volume counts can be deduced with these devices, if they are placed on the legs of an intersection, but not as effectively as other methods.

Intersection traffic volume counts are normally conducted by points three and four above. Manual counts at busy intersections often require more than one person to do, which can make it labour-intensive and therefore expensive. However, much more data than just traffic volumes can be recorded.

Intersection traffic volume count data used in this project was obtained from the Toowoomba City Council along with their crash data. This count data is mostly taken for a period of 12 hours from 6am-6pm, and already has the correct AADT Calibration factor applied for Toowoomba. The count data can be used to help produce turning movement diagrams and measure intersection capacity.

The TCC intersection volume data is collected by a temporary intersection camera, known as CAMDAS. This Camera Data Acquisition System was developed by ARRB to process video traffic information in real time. The trailer mounted unit, 'performs speed counts and monitors traffic movements, headway and driver behaviour. This avoids the need to install physical detectors or to perform manual vehicle counts in dangerous or complex traffic situations', (Commonwealth of Australia 1992, p.2.98).

The traffic volume data received is in Annual Average Daily Traffic (AADT) and Annual Traffic format. AADT is the number of vehicles travelling past a particular point on a road/street in a year divided by the number of days in a year.

There are two main limitations with this TCC volume data:

1. Count data for all intersections is not available (mainly minor streets)
2. The count data is taken at different dates, sometimes years apart

3.4 Time Period of data

The time period selected for the crash data to analyse is a very important parameter and is dependent on the purpose of the analysis. The time period selected can have a great influence on the end result, as many factors vary with time. Ogden (1996) outlines the main factors as shown below:

- Growth factors and other changing trends
- Effects of cyclic or seasonal variations in accident occurrence
- Changes in database definitions and reporting standards
- Computer resource costs (which maybe not as relevant today)

Austroads (2004) states that crash data from five-year periods is typically used, because it provides statistical reliability. They also state that a period longer than five years can be influenced by things like changes to road features that will affect accident causes. A data interrogation system could also be used to identify problem locations using short-term (1 year) and medium-term (3-5 years) data.

Ogden (1996) also states in practice time periods rarely exceed five years. A longer time period ensures a statistically significant sample size. To obtain a large sample size with short term fluctuations smoothed, five years is optimal. If specific site data analysis is to be conducted a shorter time period is suitable because of a greater sensitivity causing more variation.

It should also be noted data beyond December 1999 is less reliable, because of the changes made to standardising the minimum reporting requirements as mentioned in Chapter 2.

With these factors in mind the time period selected for this investigation was five years, due to the scope of study being a Toowoomba area action. However specific regard has been given to intersections that had remedial works and other changes conducted within that time period. Due to both crash databases being at different levels of currency, the exact period selected began with the last crash on the 4th Feb 2006 and extends back in history to the 1st Feb 2001.

3.5 Crash Data Limitations

A crash investigation can only be as good as the data received. All data & observations have an inherent amount of error or inconsistency and there are numerous reasons for this. Some of the basic reasons relevant to intersection crash data are described below.

Missing or non reported data- Some crashes are not recorded possibly because:

- The crash damage value was below the threshold amount or injury level required for mandatory reporting

- Some people who do not want the crash occurrence known by the authorities will leave the crash scene. For example people that have crashed due to breaking the law, being under the influence of drugs/alcohol, driving with excessive speed or being involved in insurance fraud.

- Offcourse only actual crash data is recorded. An intersection may have multiple near misses before an actual crash occurs, it would be beneficial if these details were also recorded, if it was possible.

Skewed or Inconsistent Data – Data that is not quite correct or exaggerates the actual situation possible from:

- Crash data collected before & after an intersection upgrade or other change over time like, speed zone changes, road resurface or vehicle improvement

- Different individual interpretations in information collection, due to human data collection and many different people collecting because of geography & time periods.

- Police can cause people to be apprehensive, which may not yield the true information. The police may not be determined to find the true cause or infrastructure contributing factors of the crash, but to find a faulty party to charge. Police also have crash scene management tasks to do.

- Mistakes in data collection or input

Limitations on the accuracy of Crash Data have been well documented in Austroads (2004, p. 31), which seems to be sourced from Ogden (1996), with main headings:

- Systematic reporting bias
- Random reporting bias
- Subjective bias
- Reporting errors
- Coding errors
- Location errors
- Discontinuities over time
- Delays
- Masked or hidden problems

With the Police being the original data source for this project, some of their known limitations should be mentioned. 'Police accident records from which the Police database is constructed are fraught with problems of data integrity and reliability. Four of these problems are discussed here', (Giles 2000, p. 7).

1. Accident reports completed by a Police Officer might be recorded correctly; it may be the public who make errors of omission because they are inexperienced in completing the form. Also due to time restraints police records tend to have many blank fields, (Giles 2000).

2. No internal verification procedures for data collection or the data entry procedures exist.

3. Some variables with accident causation and injury outcome information is sometimes missing, such as alcohol/drug involvement or seating position, (Giles 2000).

4. Some variables appear to be recorded less reliably than others, for example crash severity usually only defines the most severe injury for road users involved in the crash and not lesser injuries. Sometimes the police may write down hospital admittance when the person gets taken away in an ambulance, but they may never have been admitted.

Many other authors list the limitations of crash data, for a very critical view the reader is directed towards Hauer (1997, p. 36).

4 Intersection Classification System

4.1 Introduction

As mentioned in previous chapters, roads/streets are classified by their functional hierarchy and crashes are classified by the traffic movements leading up to the crash, so it makes sense to also classify intersections.

For this project the selection of an appropriate intersection classification system is essential, as it forms the basis for further data analysis. The classification system must make it able to compare and group the intersections of Toowoomba which have "like" characteristics. It follows along the lines of comparing "apples with apples".

The formulation of such a classification system is not as easy as simply classifying all Roundabouts and all Y-Junctions, etc, because there are so many more variables and features involved in a road/street network. Most of the main intersection features are listed below that could be eligible for use in a classification system. Some of these features are relatively minor and are consequentially not likely to be selected, e.g. intersection orientation. Other features are highly variable and cannot be grouped, for example intersection drainage characteristics.

Strictly geometrical intersection features include:

1. Intersection type e.g. roundabout, cross, T-Junction, etc. & size
2. Number of carriageway lanes and/or divided
3. Traffic lane & road reserve widths
4. Sight distances
5. Curves, crests/sags or grades
6. Intersection drainage including curbing type & cross fall
7. Protected turning lanes phasing
8. Slip lanes
9. Number of intersection legs
10. Traffic islands & marking
11. Intersection leg angles

12. Intersection topography
13. Intersection orientation

Other intersection features include:

1. Level of service
2. Intersecting road volumes & directional split
3. Road surface texture, e.g. asphalt or spray seal and condition, etc.
4. Signalised, Traffic Sign type or No Controls
5. Area zoning, e.g. residential, industrial
6. Regulatory speed zone
7. Locality & surrounds e.g. outside a shopping centre or rail crossing, etc.
8. Street Lighting

As mentioned in chapter 2, the road/street hierarchy designation is a classification system for roads or streets. The Road Hierarchy has got the following characteristics assigned to it (either built into it or related in some way):

- Typical intersection spacings
- Access vs. Mobility trade off
- Traffic Volumes
- Traffic Control
- Speed zones
- Amount of lanes and their widths

For example an Arterial road should preferable have more than one lane in either direction for high mobility with higher speed zones to pass a higher volume of traffic, or alternatively local access streets usually won't have signalised traffic control. Therefore, the road hierarchy designation is a very powerful single designation and therefore selection of the road hierarchy is a logical parameter to include into a classification system.

4.2 Intersection Classification System Development

Several categories of intersection features were considered for the grouping system of the three main categories applicable to Toowoomba being:

1. Road Hierarchy
    a. Arterial
    b. Sub-Arterial
    c. Trunk Collector
    d. Local Collector
    e. Local access/place streets

2. Intersection Type
    a. Roundabout
    b. Cross
    c. Multi
    d. Y-junction
    e. T-junction

3. Traffic Control
    a. Signals, protected turns
    b. Signals
    c. Stop Sign
    d. Give Way
    e. No Control

Several possible sub-groups also existed that could be incorporated into the classification system including:

- Speed zones
- Traffic volumes
- Number of lanes & width
- Proportion of heavy vehicles
- Intersection size, area & length

The goal was to design an Intersection Classification System that was uncomplicated yet powerful. The first logical part of the classification system was to combine the hierarchies of the intersecting roads. As discussed previously, this effectively incorporates many intersection features in one. This first stage of classification is shown below; obviously this was built to suit the Toowoomba road hierarchy.

Table 4-1: Stage One - Intersection Classification

Road Categories

	A	S	T	L
A	○	□	◊	◊
S	□	○	□	◊
T	◊	□	○	□
L	◊	◊	□	○

The ○, □ & ◊ shapes are the indicative compatibility of intersections as described in section 2.6. It can be seen that this first step places an intersection in one of sixteen categories. In the second stage intersection type was considered, even though it is somewhat influenced by the road hierarchy (in a limited way), it was deemed the single most important intersection attribute.

At this point it was becoming obvious that there was going to be too many classification combinations if all five intersection types were applied as listed above, especially considering the majority of intersections are "cross" configuration. It was decided to combine Multi intersections with Y-junctions and any other unusual intersections to form a miscellaneous category. This is justified by the fact these intersections are relatively limited in numbers and all have different angles of incidence giving to much variety. Therefore the second part of intersection classification became:

Table 4-2: Stage Two - Intersection Classification Combinations

Intersection Codes

		A-A	S-S	T-T	L-L	A-S	A-T	A-L	S-T	S-L	T-L
Roundabout	O	A-A . O	S-S . O	T-T . O	L-L . O	A-S . O	A-T . O	A-L . O	S-T . O	S-L . O	T-L . O
Cross	+	A-A . +	S-S . +	T-T . +	L-L . +	A-S . +	A-T . +	A-L . +	S-T . +	S-L . +	T-L . +
Multi/Y junction	Y	A-A . Y	S-S . Y	T-T . Y	L-L . Y	A-S . Y	A-T . Y	A-L . Y	S-T . Y	S-L . Y	T-L . Y
T junction	T	A-A . T	S-S . T	T-T . T	L-L . T	A-S . T	A-T . T	A-L . T	S-T . T	S-L . T	T-L . T

The above table is one long horizontal table but shown in two parts to fit the page.
By combining hierarchies of the intersecting roads with intersection type forty combinations are produced, however not all are possible due to incompatible intersections.

With forty combinations it was debated whether traffic control method or any other features be incorporated into the classification system. It was recognised the road hierarchy (if correct) would mostly take account of the remaining features. Nevertheless, traffic control may not be addressed adequately, so it was to be considered separately if an issue arose, such as having traffic signals and stop signs in the same class. The final classification system adopted for use in this project is shown on the next page.

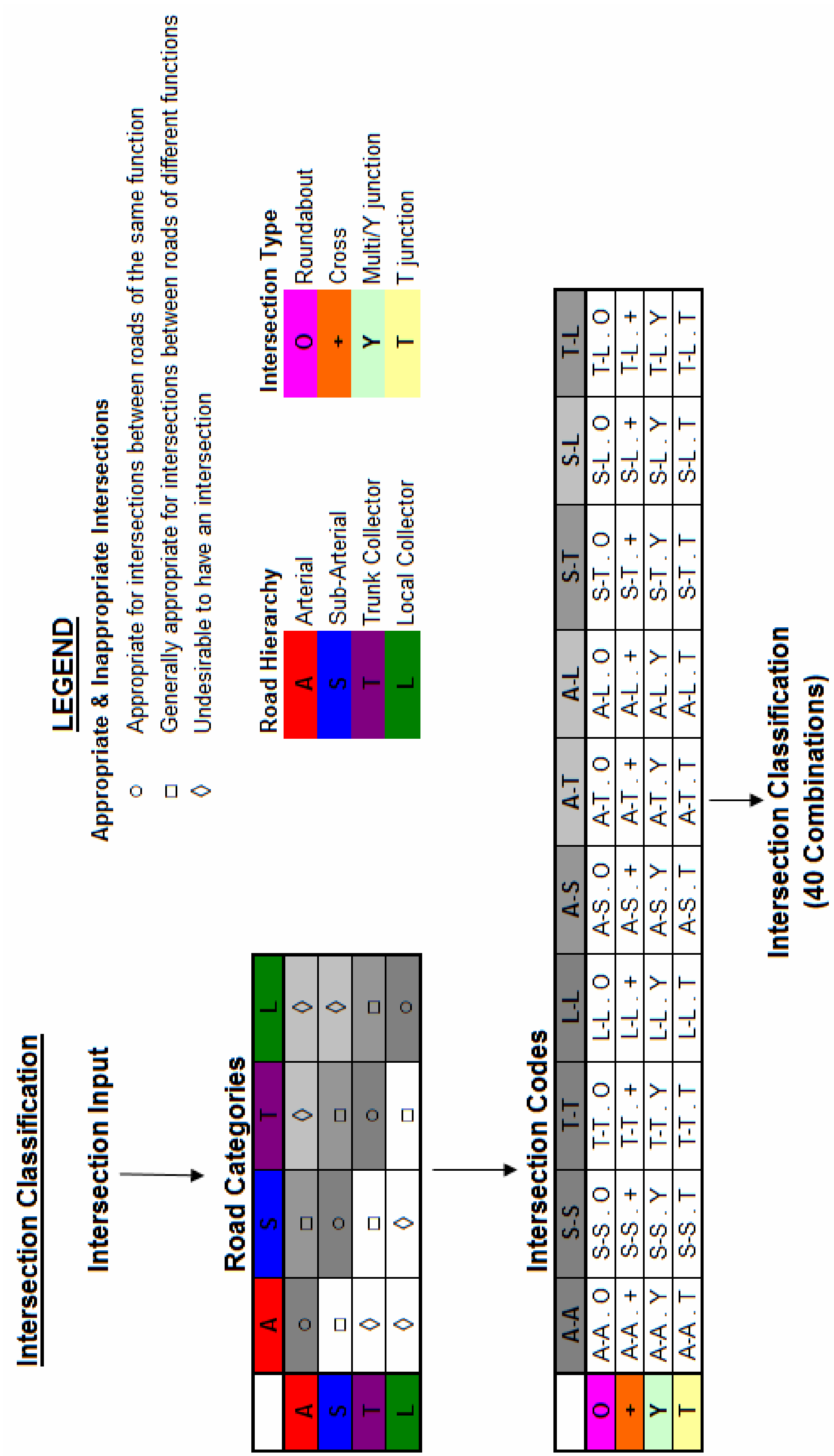


Figure 4-1: Intersection Classification System

The original classification system formulated had 70 class combinations, which was obviously too many for the medium size city of Toowoomba (can be viewed in appendix E2). Other variations of this were tried, with the final system restricted to 40 combinations by:

- Local access/place streets & local collectors merged
- Combine multi-intersections with Y-junctions
- Traffic control no included

Incorporating local access/place streets into the local collector designation, was deemed possible after it was decided to narrow the study scope to the worst 100 intersections; only four local streets were upgraded to local collector. These four streets are fairly popular among motorists and may be bordering on some local collector traffic volumes they are listed below:

1. Perth St
2. Hurstway Ct
3. Erin St
4. Phillip St

The other classification area that narrowed the combinations is intersection type, as mentioned previously. Although the classification system may seem too simple, it was concluded that every intersection is very unique and developing a system incorporating each feature would create too many permutations, making comparison difficult.

4.3 Alternate Classification System

After applying the above classification system to the Toowoomba City crash data, it was evident that the system could do with some improvement. It was discovered that due to having 40 possible classification combinations applied to the worst 100 intersections, around half the intersection codes had no intersections in them. Another issue was having a “cross” intersection majority with 72 out of the top 100, which dominated the coding.

A further refined second version of the Intersection Classification System was formulated after data analysis, so it was not applied in this project. The new system has the same structure as the old, but instead is based on a scoring system making it more analogue. Intersections are not grouped by a particular code; instead grouping would occur by score ranges. This would have the advantage of allowing these ranges to be manipulated in order to achieve a fine tuning to the collection of intersections.
The example of the second Intersection Classification System can be seen in appendix E1.

5 Investigation Method

5.1 Introduction

This chapter outlines the investigation method steps used in this crash investigation, why certain decisions were made and sample outputs along the way. This investigation method chapter culminates techniques and information derived from the last three chapters. Much of the background information, methods and influencing factors have already been mentioned in the Literature Review (chapter two). Crash data specific factors and relevant information has been discussed in Data Sources & Limitations (chapter 3) and the Intersection Classification system was developed in the previous chapter (chapter 4).

The investigation is broken up into four major parts as shown below and discussed in further detail in the following sections:

1. Crash data preparation
2. Toowoomba wide characteristics of crashes
3. Intersection classification system application
4. Grouping and comparison of intersections

5.2 Crash Data Preparation

It was decided that all data processing and analysis would be conducted in Microsoft Excel. This is because it is the standard software most people use for low to medium level analysis, plus all the crash data was already in spreadsheet form. The 2003 software version provided the necessary functions required for this investigation with vast familiarity. If greater data analysis abilities where required, a specialised "add-in" software package could have been installed.

The raw data as received from the road authorities was utilised in the production of some basic comparison statistics and charts. For the remainder of the project, the data had to be prepared for use. The main steps used in the preparation of crash data is as follows:

1. Retrieve all possible data required for the project
2. Preliminary data comparisons
3. Exclusion of all data outside project scope
    a. Non-Intersection data
    b. Crashes outside of Toowoomba area
    c. Data outside specified 5 year time frame
4. Scope narrowed to TCC top 100 worst intersections
5. DMR & TCC Data Merged (after classification)

After obtaining road crash data from both TCC and DMR it was necessary to select the best data to use. Originally it was decided to use the DMR data due to the amount of information fields provided and the possibility of greater data integrity. However after initial observations and discussions with both TCC and DMR, the data that may suit this investigation changed to the TCC data.

The DMR data seemed to have much less crash entries per intersection, a point both parties acknowledged as possibly occurring. The other major attraction to the TCC data was, it appeared to come as more of a "complete package" for this type of analysis. The main information that was enclosed that DMR did not have was:

- Major intersection traffic volume data
- Road hierarchy information
- The last major intersection treatment and date

Further comparisons were made between the two sets of data with both sets having their own strengths and weaknesses. It was noted that some crash events that were in one set of data, were not in the other set of data and vice versa. Other discrepancies in the data became apparent, as detailed in chapter 6.

In order to obtain a superior data set to work with, it was decided to combine both TCC and DMR data to get the best from both of them and maximise the data available. It was determined this merging of the data was credible, because both sets of data should be compatible, as they both came from the same source originally (the police). It later turned out this merging of the data provided a way of discovering errors in the data, thus verifying its accuracy.

5.2.1 DMR Data Preparation

Department of Main Roads crash data in raw form included over 18,800 crash entries counting many areas outside Toowoomba. Therefore it was necessary to isolate intersection crashes to Toowoomba only. This was done by excluding all non Toowoomba crash data, using the "AREA" field. Therefore everything outside the Toowoomba City Council boundary was excluded, by using the "sort" command and delete. Refer to appendix D for a DMR crash data sample and page D6 for the main data field codes.

Using the same method all non-intersection crash data was excluded with the "ROAD_FEATU" field. Intersections are isolated as roadway features 10 – 15 as seen below in italics. No interchanges exist in Toowoomba and railway crossings were not considered for comparison with conventional intersections.

Table 5-1: DMR Road Feature Field

Feature Of Roadway Code Description	"ROAD_FEATU"
10	*Cross*
11	*T junction*
12	*Y junction*
13	*Multiple Road*
14	*Interchange*
15	*Roundabout*
20	Bridge, Causeway

30	Railway Crossing
40	Median Opening
50	Merge Lane
90	Miscellaneous
99	Not Applicable

Next the judgement was made to exclude all crash data associated with illegal activities, such as alcohol, fatigue and speeding. This is because this investigation is designed to study crash events and try to offer a possible remedial treatment which is impossible to do if there is such disregard for the law by drivers. For example, there is no sense trying to determine a remedial treatment for an intersection if the cause of the accident/s was due to the car travelling at double the speed the intersection was designed for.

However, it was later recognised many such illegal activities could be still getting recorded as crash events without their true cause of undertaking in illegal driving been known. It is also acknowledged that the true underlying cause of a crash could still be a substandard intersection if the driver was for example, under the influence of alcohol. Meaning, the driver that appeared to be at fault by illegally driving could have reacted as competently as anyone else the same situation. All other crash studies considered did not remove this illegal driver behaviour crash data; therefore it was decided to retain it in the data set.

As mentioned previously the time period selected for this investigation was five years, with specific regard given to intersections that had works conducted within that time. Therefore all crash data outside of the last 5 years was excluded, beginning with the last crash on the 4th Feb 06.

5.2.2 TCC Data Preparation

The Toowoomba City Council data was somewhat easier to initially process. It had over 12 800 data entries all of which were in Toowoomba. There were around 800 non-crash entries that had to be excluded. These entries are the last major intersection treatments entered as an event. Non-Intersection crash data was simply excluded by use of a spreadsheet filter, selecting "True" in the "INT" field. Like before, all crash data outside of the 5 years was excluded.

5.3 Toowoomba Crash Characteristics Method

Although the main scope of this project is the comparison of intersections by classification, it seemed appropriate to investigate some trends and determine which accident type is the most common.

All the data used in this analysis was taken from the DMR database, due to it having adequate information fields to use. The graphs were produced by similar methods in the spreadsheet by selecting the required information, using the "Count if" function and dividing (if pie graph) that frequency of occurrence by the total number.

For example: The 5 Year Toowoomba Intersection Crash by Feature of Roadway (%) graph was produced by (pie graph):

1. Using the 5 year intersection crash data for all of Toowoomba
2. Using the "count if" to count the number of occurrences of intersection roadway crashes by feature. E.g. 757 T-junction crashes were found by counting each "11" in the DMR "ROAD_FEATU" field.
3. The percentage was found by dividing the above result with the total number of crashes and rounding off. E.g. T-junction crash percentage of total crashes is 757/2113 = 35.8%.
4. Process repeated for each road way feature.

Often for graph clarity several low occurrence items were grouped to form an "other" category. This category is described under the title and generally occurred when the item was below one percent. The bar graphs were produced in a similar way using a count only, without the percentage of total calculation.

Refer to chapter 6.2 - Toowoomba Crash Characteristics, for the display and discussion of these graphs.

5.4 Classification of Intersections

The adopted classification system development is mentioned previously in chapter 4, with figure 4.1 displaying the actual intersection classification system used.

5.4.1 Toowoomba Hazardous Road Locations

In theory applying the classification system seemed fairly straight forward at first, but the application became a monstrous task for the following reasons:

1. The apparent intersection hierarchies contained in the TCC crash data was not suitable for the classification system.
2. There maybe over one thousand intersections in Toowoomba.
3. The road hierarchy along a road or street often changed along its length.
4. The road hierarchies had to be read off the colour coded PDF map.

Therefore to avoid classifying many intersections only to eventually use the crash data for several relevant intersections, it was decided to seek the most Hazardous Road Location (HRL) intersections. This can be done in many ways as described in chapter 2; however TCC already had developed a top 300 list of the worst intersections.

The TCC crash ranking is fairly simplistic being based on the number of accidents within a last five year time frame. This ranked list was deemed to be sufficient for the purpose of this project, with all intersections in the top 100 to be classified.

5.4.2 Intersection Classification System Application

The classification procedure is fairly self-explanatory after describing how it is developed in chapter 4. The basic steps are as follows:

1. Identify intersection to classify
2. Find out the hierarchies of the individual intersecting roads or streets and input as letter. (see figure 4-1 for keys)
3. Determine intersection type and input as symbol
4. Combine the letters and symbol to form one of 40 classification codes

As mentioned previously the scope of study was narrowed to the TCC identified Top 100 Intersections for classification. The intersection classification system was applied by; labelling the road hierarchy from then TCC planning maps into TCC top 100 spreadsheet, for each intersecting road/street.

Note- road hierarchy can change along a roads length.

- If hierarchy changes at the intersection, use the higher rank.
- Local streets could upgraded to local-collector streets

The intersection type information had to taken from the DMR crash data and put into TCC top 100 list where classifying. Table 5-2 below shows the classification of the top 10 worst Toowoomba intersections. The process was made fully automated in the spreadsheet with the exception of hierarchy entry.

Table 5-2: TCC Top 10 Intersection Classes

99-03 CRASH RANK	MAJOR STREET	Road Category	MINOR STREET	Road Category	DMR code - ROAD_FEATU	Intersection Type	**Intersection Classification**
1	BRIDGE ST	A	TOR ST	A	10	+	**AA+**
2	JAMES ST	A	WEST ST	S	10	+	**AS+**
3	HUME ST	A	JAMES ST	A	10	+	**AA+**
4	HURSLEY RD	T	TOR ST	A	10	+	**TA+**
5	ALDERLEY ST	T	RUTHVEN ST	A	10	+	**TA+**
6	RUTHVEN ST	A	STENNER ST	T	10	+	**AT+**
7	TAYLOR ST	S	TOR ST	A	10	+	**SA+**
8	BRIDGE ST	S	HOLBERTON ST	T	10	+	**ST+**
9	JAMES ST	A	RUTHVEN ST	A	10	+	**AA+**
10	CLIFFORD ST	T	HERRIES ST	S	10	+	**TS+**

During classification some borderline classes had both signalised and non-signalised intersections within them, which should not really be compared as "like". This may mean the classification system needs this extra feature incorporated, or the non-signalised intersections could become eligible for signalisation in the near future.

At the other end of the traffic control scale, some may argue a "give-way" intersection may behave in a similar fashion to a "no control", which has the "give way to the right" rule in force anyway.

5.5 *Grouping and Comparison of Intersections*

Intersections were grouped from the three main intersection families; roundabouts, t-junctions and cross intersections. Two or three intersections formed each class representation, each with their own crash data set. However many classes did not have sufficient intersections in which to compare, see section 7-4-2 for more detail.

This section forms the core of the project with the main investigation following these basic steps:

1. Select intersections groups to analyse for several intersection types, considering the group should have sufficient intersections.
2. Remove intersections with major works within the specified 5 year period.
3. Import corresponding intersections crash data from TCC database and then import DMR data to merge.
4. Carry out an analysis of the crash data, specifically looking at:
    - Data anomalies
    - Trends in dates, wet roads, directions and vehicle types
    - Charting of DCA, time of the day, day of the week and severity
5. Compare trends with classification groups and conclude

5.5.1 Intersection Grouping

The grouping procedure involved finding adequate intersection groups suitable for comparison. Which groups of intersections to compare was actually made easier by having a limited class range to select from, while having to many intersections in a group was a disadvantage. Each intersection classification was tallied, with the main two intersection types shown in the table 5-3 as a guide.

Table 5-3: Cross Intersection Road Categories by Count

Cross Intersection by count

+	A	S	T	L
A	4	10	14	5
S	-	3	13	2
T	-	-	13	6
L	-	-	-	2

Round Intersection by count

O	A	S	T	L
A	0	0	0	0
S	-	2	5	1
T	-	-	6	0
L	-	-	-	1

The above table is part of the tallying of intersections, where for example out of the top 100 intersections 4 were A-A.+ and 1 was S-L.O

Table 5-4 below shows the initial intersection groups that were suitable for comparison. Not all of these groups were analysed and several intersections were culled.

Table 5-4: Initial Intersection Groups to Compare

EXAMINE		COMPARE	EXAMINE		COMPARE
A-A+	4	Worst Ints	A-TT	2	
S-S+	3	All +	L-ST	3	All T
S-A+	10	5 max	L-AT	5	
T-A+	14	5 max			
A-L+	5		S-SO	2	O vs +
			S-S+	3	
S-SO	2				
S-TO	5	All O	A-L+	5	T vs +
T-TO	6		A-LT	5	

Intersections were removed from the grouping if:

- There were too many intersections or too many in one class whilst another class had few.
- The intersection received an upgrade or major treatment during the 5 year period. E.g. traffic signal installation
- Intersection has insufficient crash data

Once suitable groups were established for comparison, intersection crash data was analysed.

5.5.2 DMR & TCC Data Building

Firstly with the intersection as part of a group identified, the relevant TCC data was put in a new spreadsheet worksheet. This was conducted by use of filters to select the major street then minor street that make up the intersection, which then outputted the crash data by use of a small macro. This was done for each intersection in the group.

As mentioned previously the TCC crash data was to be merged with the DMR data to achieve a strong dataset. This was done via the unique crash number; however each database had different ways of forming this number.

To merge the data, it was recognised that the "ACC_NO" field in the DMR data had the same last five numbers (disregarding zeros) as the "INCID_NO" field in the TCC data. This accident/incident number was the unique identifier for the crash event that had been constructed differently when combined with the year the crash occurred. For example for the same crash event in 2005, the DMR "ACC_NO" is 20050001494 and the same crash TCC "INCID_NO" is 05/1494.

To make matters worse 35% of the TCC data did not have an incident number assigned to them. So matching this proportion of TCC data to the DMR data would have to be done by the cumbersome method of matching an intersection, date and time manually. Therefore only data from intersections of interest was selected and merged for further analysis.

This manual matching of data was very time consuming, so it was given up on. Matching data was eventually conducted by using a "VLOOKUP" function in the spreadsheet. This meant 35% of DMR crash data and any extra DMR data that exists, (that TCC database did not have) was not included for some of the intersections. This was only made possible by using the "CONCATENATE" function to change the DMR "ACC_NO" into the TCC "INCID_NO" form.

5.6 Data Analysis & Charting Methods

Once all the crash data was setup and entered into the appropriate worksheets, preliminary analysis began. This mainly involved examining the crash data for anomalies, trends in dates, wet roads, vehicle directions and types. A typical example of the main features examined is tabulated below.

Table 5-5: Intersection Basic Notes Example

NOTES:			**Rank**	25	**TSO**	
Wet Crash-	0%		**Pred. fault car dir.**	North	bound	
% of Cars -	88%	(or ute)	**Speed Limit**	60	km/h	
% of Mtr Bke -	6%		**Traffic Control**	Give way sign		9

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL
6/20/2002	Thursday	7-9am & 3-5pm	6,532	3.14	20,541

Often throughout this chapter, intersections are referred to by the TCC top 100 ranking. The above tabulated notes are taken from the intersection of Alderley St & Drayton Rd, which is ranked number 25 and is classified (in this project) as a T-S.O, (Trunk Collector – Sub-Arterial . Roundabout). All the primary intersections analysed in this project are contained in Appendix G - Intersection Profiles, with the following details:

- Basic crash details for the intersection for the last five years
- Tabulation of basic notes
- Volume data
- Satellite photo

After initial analysis and examination of the appropriate intersection groupings, the following list of intersections of interest was formulated as seen table 5-6. The three left columns show the different intersections with the same class to be explored further.

Table 5-6: Intersections of Interest

T	O	+	99-03 CRASH RANK	MAJOR STREET	Road Category	MINOR STREET	Road Category	DMR code - ROAD_FEATU	Intersection Type	Intersection Classification	CONTROL
		j	1	BRIDGE ST	A	TOR ST	A	10	+	AA+	signals
		j	3	HUME ST	A	JAMES ST	A	10	+	AA+	signals
		h	12	LONG ST	L	RUTHVEN ST	A	10	+	LA+	signals
		j	15	ANZAC AVE	A	JAMES ST	A	10	+	AA+	signals
a			16	JAMES ST	A	WATER ST (South)	L	11	T	ALT	traffic signs
	e		25	ALDERLEY ST	T	DRAYTON RD	S	15	O	TSO	roundabout
	f		26	HURSLEY RD	S	McDOUGALL ST	S	15	O	SSO	roundabout
c			28	BRIDGE ST	A	McGREGOR ST	T	11	T	ATT	signals
		g	33	PERTH ST	L	RUTHVEN ST	A	10	+	LA+	traffic signs
		i	35	BRIDGE ST	S	WEST ST	S	10	+	SS+	signals
		i	44	HERRIES ST	S	WEST ST	S	10	+	SS+	signals
c			47	BRIDGE ST	A	GREENWATTLE ST	T	11	T	ATT	traffic signs
	d		52	RAMSAY ST	T	STENNER ST	T	15	O	TTO	roundabout
	f		61	HUME ST	S	STENNER ST	S	15	O	SSO	roundabout
b			65	TAYLOR ST	S	WYALLA ST	L	11	T	SLT	no contol
		h	79	JAMES ST	A	MACKENZIE ST	L	10	+	AL+	signals
	e		80	ALDERLEY ST	T	HUME ST	S	15	O	TSO	roundabout
		g	89	NELSON ST	L	RUTHVEN ST	A	10	+	LA+	traffic signs
a			94	BRIDGE ST	A	RICHMOND DR	L	11	T	ALT	signals
	d		98	GREENWATTLE ST	T	HURSLEY RD	T	15	O	TTO	roundabout
b			100	O'QUINN ST	L	WEST ST	S	11	T	LST	no contol

The main comparisons of the crash data come in the form of pie and bar graphs. The key characteristics being analysed are:

1. Annual Crash Occurrence by Intersections Class
2. DCA Column Groups
3. Crash Occurrence by Severity
4. Crash Occurrence by Time of Day
5. Crash Occurrence by Day of Week

These were chosen due to limitations of the available data and these are the main characteristics common to all crashes that should present unique patterns between the classes.

All of the subsequent graphs in the next chapter have data that is combined with other intersections of the same class. For example the DCA data for class T-T.O is the combination of intersections ranked 52 and 98 to form a combined pie graph. The majority of these are only pairs of intersections. It was desired to have more data sections in each class, but after the intersections were eliminated for various reasons this was not possible.

Although this joining of the data may seen like an invalid technique initially, it is dependant on the reliability and validity of the classification system. Meaning if the classification system is infallible, then multiple intersections of the same class should exhibit the same crash characteristics and respond the same to applied remedial treatments. This forms the main experimental part of this project.

The techniques used to generate the graphs are outlined below, some of which has been explained in section 5.3 and applied in section 6.2. The main method involves breaking the feature into set ranges and counting the occurrence of each part. For example breaking the hours in the day into 2 hours blocks, and counting how many crashes occurred in each block.

1. Annual Crash Occurrence by Intersections Class graph

This is a basic count of the number of occurrences of crashes per year. It gives a rough idea of whether the number of crashes is increasing or not.

2. DCA Column Groups graph

This is the single most important part of the crash information because it classifies the crash, as mentioned in chapter 2. This DCA pie graph uses the columns of the coding system which are based on the traffic movements leading up to the conflict situation. These DCA sub groups span 10 different ranges from 0-99, 100-199, etc, up to 900. For the full meaning, the Australian DCA codes in figure 2-11 must be referred to.

As mentioned DMR also use the "Nature of" crash field, which is similar but not the same as the DCA system. The DCA has been used due to its widespread acceptance.

3. Crash Occurrence by Severity graph

This graph displays the number of crashes by severity. The DMR severities are shown in table 5-7.

Table 5-7: DMR Severity Code

Severity of Injury	"SEV_CODE"
1	Fatal
2	Admitted to Hospital
3	Received medical treatment - not admitted
4	Minor injury - first aid or no treatment
5	Property damage only

The last two are important but need no explanation.

4. Crash Occurrence by Time of Day graph
5. Crash Occurrence by Day of Week graph

Analysis was then undertaken in the form of:

- Compare intersection data with other area data, features and causes
- Compare general trends and differences between classification groups
- Review temporal trends by years, days and hours
- Examine crash patterns with respect to intersection attributes
- Review traffic control and basic intersection design

Crash data analysis in this project did not go into much detail with individual intersection level of analysis because the main aim was the comparison of intersection classes. For example, collision diagrams & factor matrices were not used.

6 Discuss of Results

6.1 Introduction

This chapter is dedicated to the presentation and discussion of results derived from the methods and steps outlined in chapter 5 and other chapters previously.

Note – Some graphs presented in this project have the same data used in other graphs, however during charting default colours have been assigned by the spreadsheet and may be different between graphs. For example “angle crash” is assigned purple on a pie graph but may be red on a different graph.

6.2 Toowoomba Crash Characteristics

This section displays and discusses graphs that apply to the whole of Toowoomba in the nominated 5 year time period. Some graphs contain a lot of data, so they are also reproduced in appendix F in full size for easy viewing.

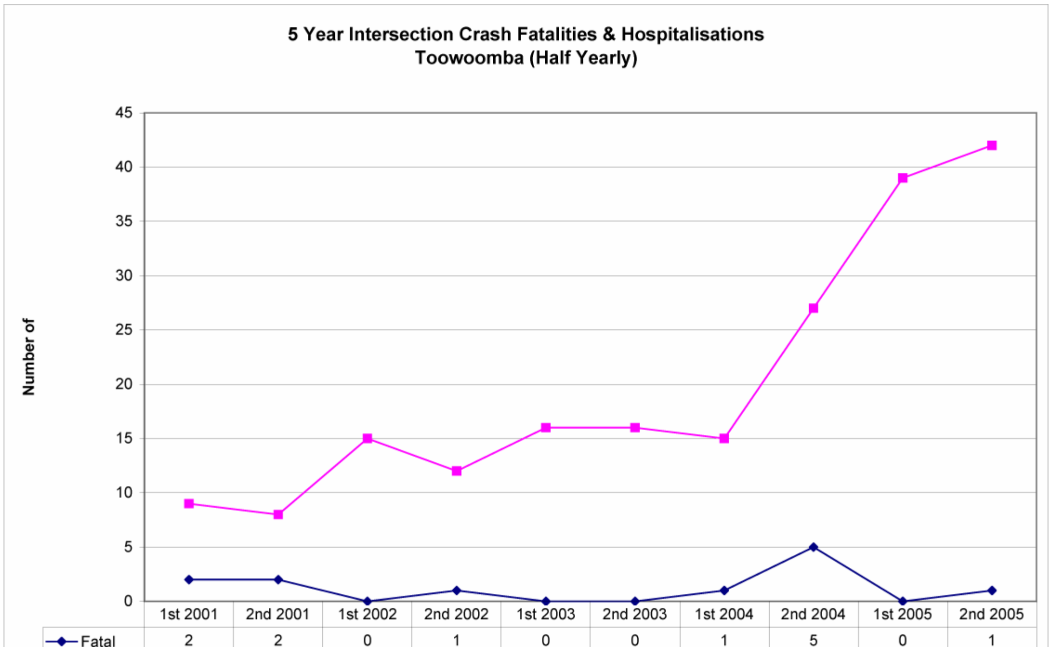
The graphs presented below were chosen because of their importance, a myriad of other graphs could have been produced but with lesser relevance. The presented graphs should give the reader a general feel for the basic characteristics of intersection crashes in Toowoomba:

1. 5 Year Intersection Crash Fatalities & Hospitalisations (half yearly)
2. Crash Severity Occurrence
3. 5 Year Toowoomba Intersection Crash Frequency by Year with Influencing Factors Alcohol & Speed
4. 5 Year Toowoomba Intersection Crash by Feature of Roadway (%)
5. 5 Year Toowoomba Intersection Crash by Type (%)
6. 5 Year Toowoomba All Crash by Type (%)

7. 5 Year Toowoomba Intersection Crash by Type (%) with Influencing Factors Alcohol & Speed

Figure 6-1 below displays the fatal and hospitalisation crashes for intersections only for Toowoomba, on a half yearly basis. It is similar to figure 2-6 which was on a yearly basis with the number of total crashes shown also.

It can be seen that hospitalisation crashes at intersections are approximately 10 times more likely to occur than fatal crashes. For some reason 2004 and 2005 have seen a rapid growth in hospitalisation crashes whilst fatal crashes have remained relatively flat.



	1st 2001	2nd 2001	1st 2002	2nd 2002	1st 2003	2nd 2003	1st 2004	2nd 2004	1st 2005	2nd 2005
Fatal	2	2	0	1	0	0	1	5	0	1
Hospital	9	8	15	12	16	16	15	27	39	42

Figure 6-1: 5 Year Intersection Crash Fatalities & Hospitalisations (half yearly)

The bar graph in figure 6-2 below shows the number of intersection crashes for each severity type by year. Note the years are in a reverse order to the previous graph.

This graph puts in perspective the relatively low number of fatal crashes with respect to property damage crashes. However this graph was produced with the exclusion of all crash data associated with alcohol, fatigue and speeding before it was decided to re-include the data. Therefore this graph may not exactly represent the above graph.

Statistically averaged over the five year period the following severity percentages are shown compared to the total number of intersection crashes:

- Fatal < 1 %
- Hospital 11 %
- Medical 15 %
- Minor 12 %
- Property 73 %

The graph in appendix F1 displays the same data grouped by severity level for the reader to better distinguish the trend of each severity yearly.

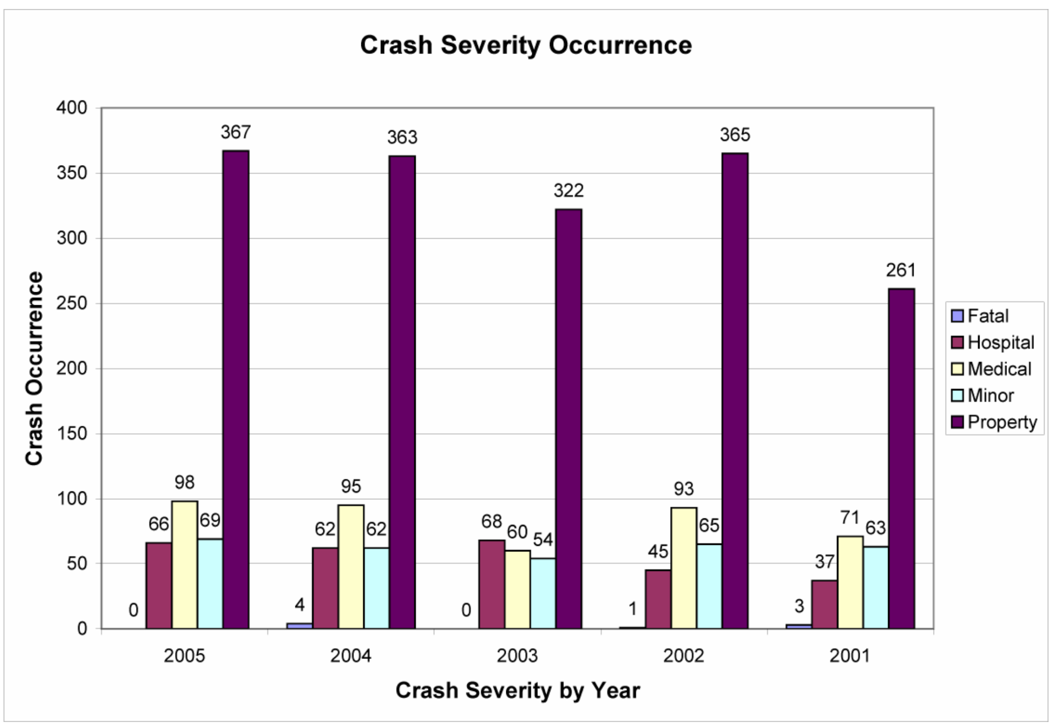


Figure 6-2: Crash Severity Occurrence

Figure 6-3 below gives an understanding of the number of reported crashes due to excess speed and alcohol consumption against crashes that appeared to be caused by an accident not contributable to an illegal behaviour. Although the data set for these illegal behaviours is small.

The trends can be seen there is an upward trend of legal behaviour crashes due to an increase of vehicle traffic. Conversely crashes contributable to speed appear to be trending down, which suggests the Police anti-speed campaigns are working. With drink driving campaigns functioning to some extent, holding a steady crash level against growth.

The difference between the two types of crash may not be as large if the illegal behaviours could be fully detected and proved. Fatigue related crashes are even more insignificant and are thus not mentioned here.

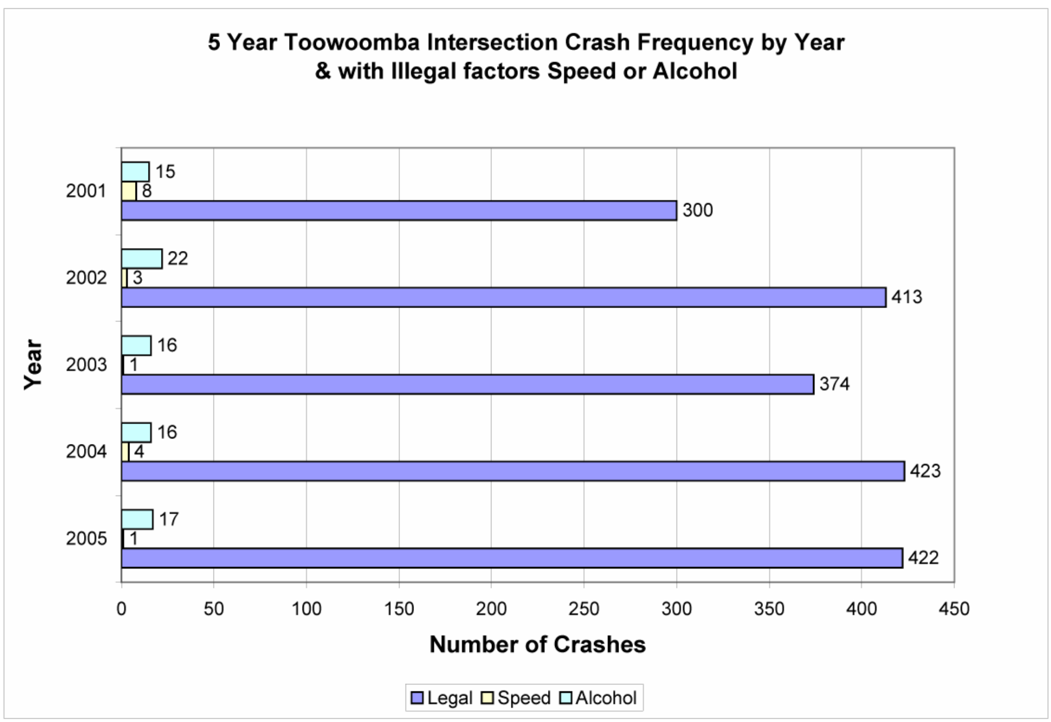


Figure 6-3: 5 Year Toowoomba Intersection Crash Frequency by Year with Influencing Factors Alcohol & Speed

Figure 6-4 below gives an idea of the proportion of crashes between the different types of intersections. This is only useful as a guide due to the non-existence of the numbers of each intersection type that are in Toowoomba. For example there could be more roundabouts in Toowoomba than T-junctions which would imply they are relatively safer. It is fact that the majority of intersections are "cross" intersections in Toowoomba, which is inherent to the standard gridiron street layout.

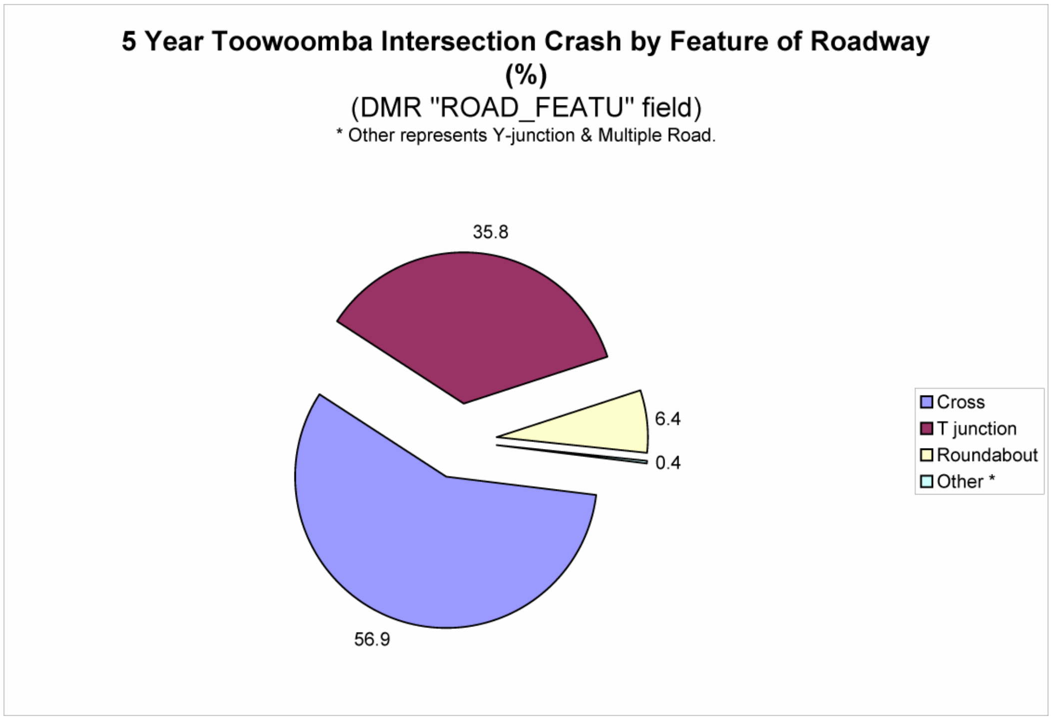


Figure 6-4: 5 Year Toowoomba Intersection Crash by Feature of Roadway (%)

The next three graphs are inter-related and refer to the DMR "Nature of" crash field, which is similar but not the same as the DCA system of crash types. All three pie graphs represent the five year period and are restricted to Toowoomba only. The graphs vary between all crashes, intersections only (by feature of roadway) and contributable to an illegal behaviour crash types.

The first graph, figure 6-5 refers to all intersection crashes that occurred by type. It can be seen that the angular vehicle impact is the major type, but this does include all angles from perpendicular impacts (slang name "t-bone") to narrow angles. A grey area does exist between what is termed an angle impact and a sideswipe.

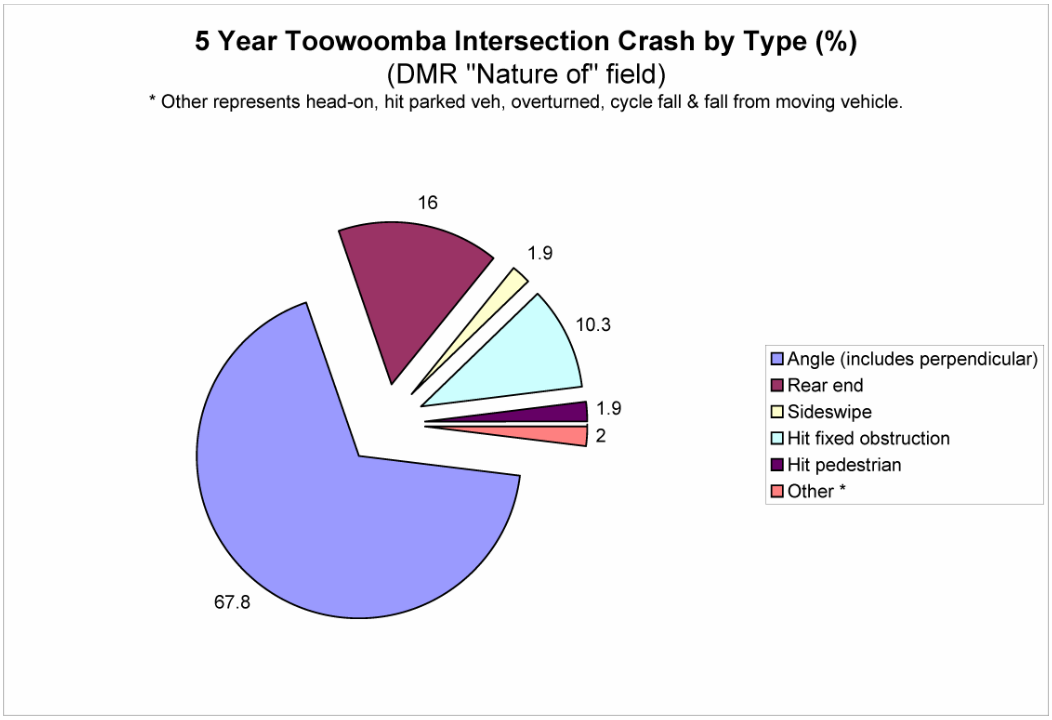


Figure 6-5: 5 Year Toowoomba Intersection Crash by Type (%)

Figure 6-6 differs from the previous pie graph by using data from all of Toowoomba, without limiting crashes to intersections only. The inclusion of mid-block crash data can be seen to reduce angle impacts and increase other types of crashes such as impacts with obstructions, vehicle rear ends and other types.

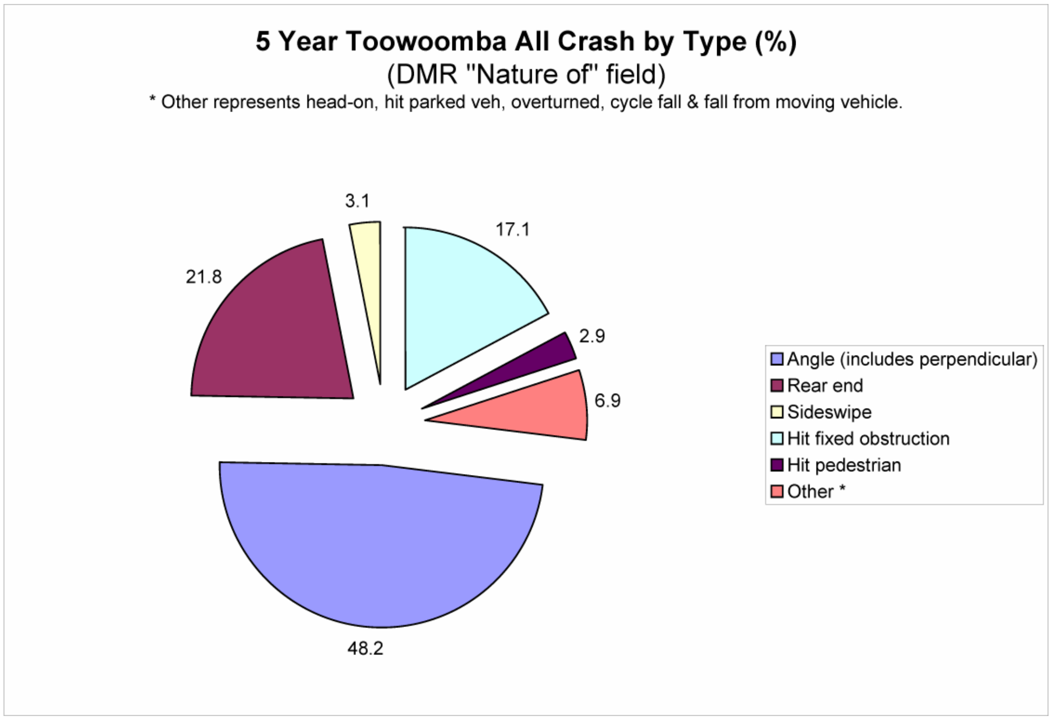


Figure 6-6: 5 Year Toowoomba All Crash by Type (%)

The final featured graph for Toowoomba wide data is shown below in figure 6-7. It uses only intersection data like figure 6-5, but this time is limited to influencing factors of alcohol and speed only. This pie graph is much different, but does only draw from a small data set as mentioned previously.

The shift in crash type is most noticeable in the “hit fixed obstruction” field, where this type of crash has gone from 10.3% to 56.3% of all crashes. It has been proven that alcohol degrades driving performance and increases the risk single vehicle crashes. The other possible reason for this large difference could be due to the fact that fewer vehicles are on the road at night whilst there is an increase in alcohol intoxicated drivers and speeding “hoons”. A rise in single vehicle crashes seems imminent with more illegal behaviour with less other vehicles to crash into.

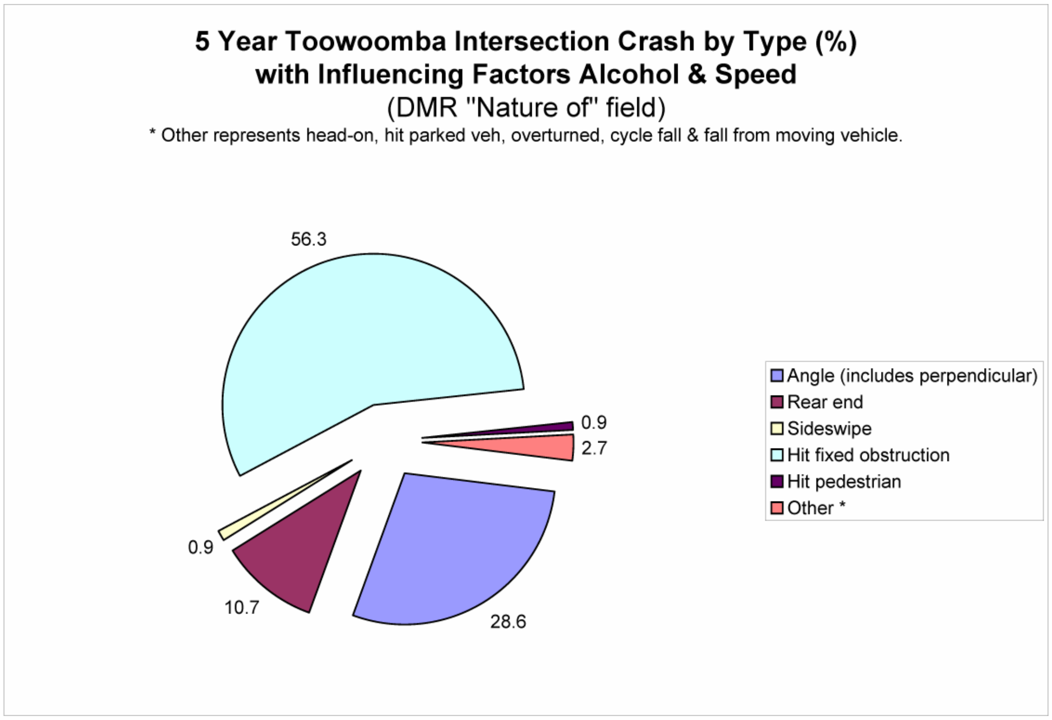


Figure 6-7: 5 Year Toowoomba Intersection Crash by Type (%) with Influencing Factors Alcohol & Speed

6.3 Classified Intersection Data Analysis & Charting

This section discusses the graphs and results for each intersection class comparison.

The original intention was to re-graph all the data correcting for traffic volumes of each intersection. This would remove the bias of a high volume intersection having many more crashes, but not truly being anymore dangerous than a low crash rate intersection. That is assuming doubling the traffic volume causes double the crash rate, thus creating the same risk.

This traffic volume correction was not conducted due to time restraints and the fact comparison could be on a proportional basis. Therefore the reader is advised to avoid simply comparing absolute values between bar graphs, but instead to compare the proportions of the bars. For example, comparing the over riding shape between graphs.

However the two pie charts are the main graphs that characterise the crash safety of the intersection, by displaying the type and severity of crashes. Both of which by nature present the data in a proportional format.

6.3.1 Annual Trend in Crashes

Annual crash trends by intersection classes where graphed for the five year period. These graphs are for basic crash rate growth information involving the intersections of interest in Toowoomba. These graphs are elementary and provide little analytical value; therefore they have been placed in appendix H - Annual Crash Trends by Intersection Type Graphs.

The results of these graphs appear to be random. However taken lightly, some conclusions can be drawn from them, such as:

- Generally there is little evidence of crash rate growth at time advances.
- T-junction crash rates reduced with time
- Roundabout crashes in 2003 occurred at over twice the rate of previous and future years.

6.4 Crash data analysis

The main project analysis occurs in the next 48 graphs, which have been grouped in lots of four by class. This has been done to save space and allow easier comparison for the reader. The electronic copy of this project (on the CD), contains a larger PDF version of the 48 intersection graphs if information is difficult to read here.

All graphs are self explanatory with the exception of the DCA Column Group pie graphs. As an aid to reduce switching back to figure 2-11, although not as simplistic, table 6-1 has been included overleaf.

Table 6-1: Main DCA Series

DCA Code Group	DCA Codes	Description
Two Vehicle Crashes:		
1	100 - 109	Intersection, from adjacent approaches
2	201, 501	Head on
3	202 - 206	Opposing vehicles, turning
4	301 – 303	Rear end
5	305 – 307, 504	Lane change
6	308, 309	Parallel lanes, turning
7	207, 304	U turn
8	401, 406 – 408	Entering roadway
9	503, 505, 506	Overtaking, same direction
10	402, 404, 601, 602, 604, 608	Hit parked vehicle
11	903	Hit railway train
Single Vehicle Crashes:		
12	001 – 009	Pedestrian
13	605	Permanent obstruction on carriageway
14	609, 905	Hit animal
15	502, 701, 702, 706, 707	Off carriageway, on straight
16	703, 704, 904	Off carriageway, on straight, hit object
17	705	Out of control, on straight
18	801, 802	Off carriageway, on curve
19	803, 804	Off carriageway, on curve, hit object
20	805	Out of control, on curve

Austroads (2004)

The first three graphs are "all road category – one type of intersection", each aggregating crash data from the main intersection types. For example one graph set has all road hierarchy combinations but one type, like roundabout.

These graphs are important being shown initially for two reasons:

1. To be used as baseline proportions for single intersection classes to reference against.
2. Provide a reliable comparison between intersection types, by having more crash data.

The first of these represents the largest and most common intersection type, being the cross intersection. The graphs (figure 6-8) are made from crash data from nine cross intersections, all of which are shown in figures 6-11 to 6-14.

The following observations can be made from the graphs:

1. Time of day seems like typical work and some night traffic
2. Day of week are reasonably flat with a Friday peak
3. Property damage accounts for just over half of all damage. This means there were no injuries sustained in these crashes, only property damage. Almost one quarter received medical treatment.
4. The DCA groups are roughly equally split into three main types:
   - I. 100 – Intersection, vehicles from adjacent approaches
   - II. 200 – Vehicles from opposing directions
   - III. 300 – Vehicles from one direction

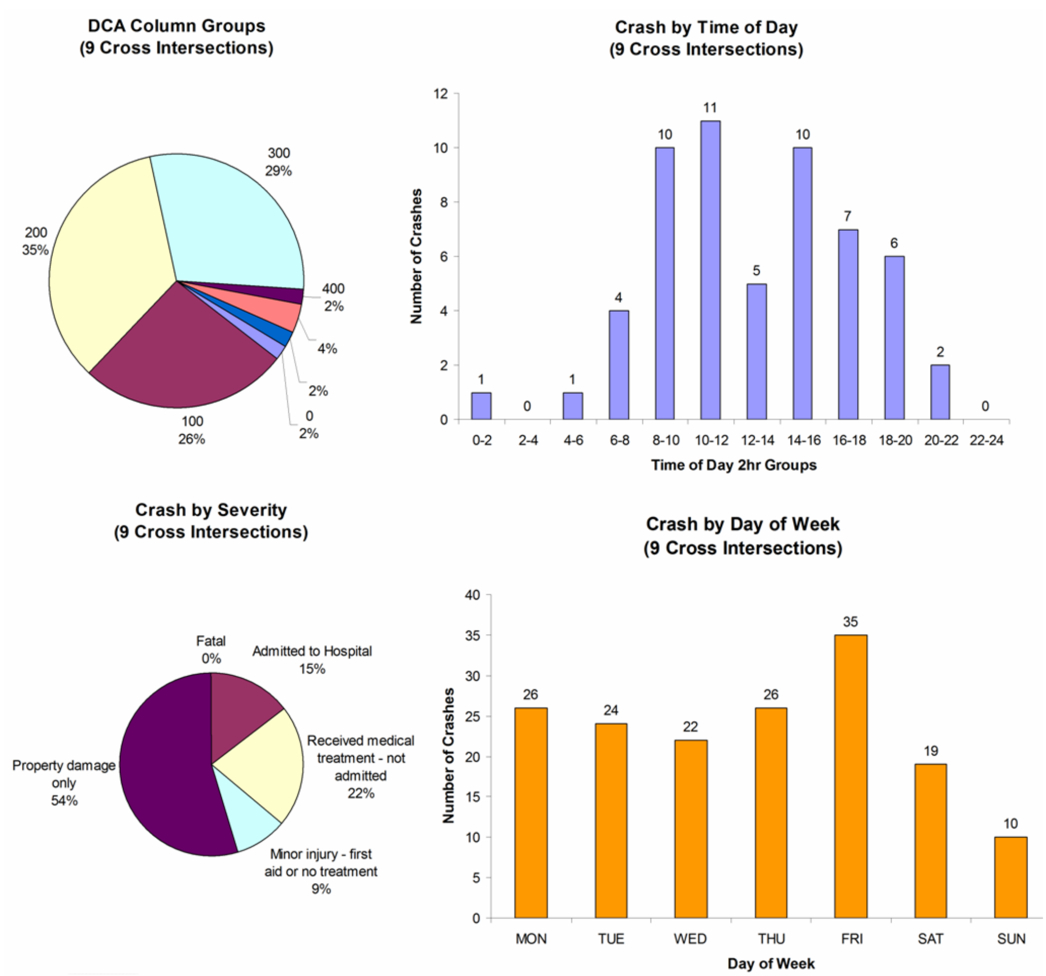


Figure 6-8: Cross Intersection (9) All Classifications Graphs

The second aggregate graphs (figure 6-9) represent six T-junction intersections. The intersections which make up the six are in figures 6-15 to 6-17.

The following observations can be made from the graphs:

1. Time of day is similar to cross intersections without the night crashes
2. Day of week crashes are similar a Thursday peak with lower weekend crashes
3. Again property damage accounts for half of all damage, with minor injury now at one quarter of all crashes.
4. The DCA groups are still split into three main types with a series 300 majority:
    I. 100 – Intersection, vehicles from adjacent approaches
    II. 200 – Vehicles from opposing directions
    III. 300 – Vehicles from one direction

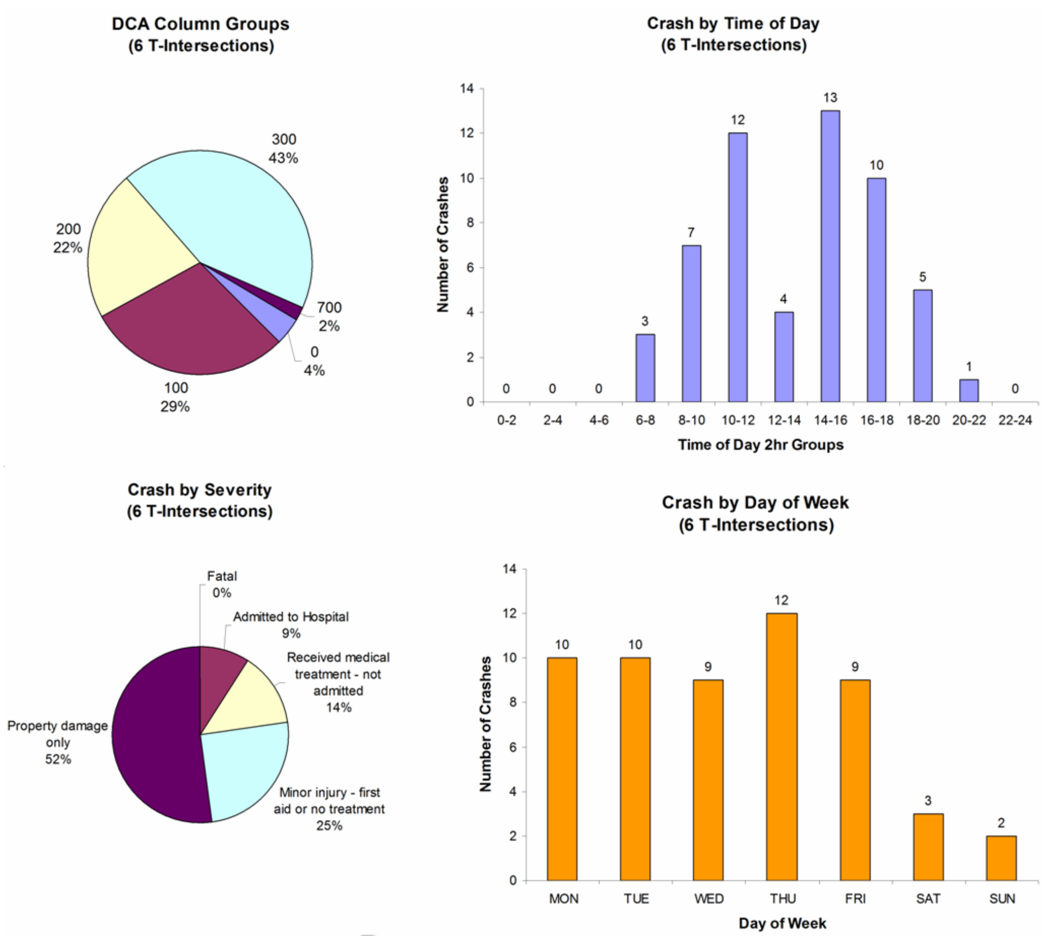


Figure 6-9: T-Junction Intersection (6) All Classifications Graphs

The third aggregate graph (figure 6-10) represents five roundabout intersections. The intersections which make up the six are in figures 6-18 & 6-19.

The following observations can be made from the graphs:

1. Time of day is a lot more spread out with a large evening peak
2. Day of week crashes are very similar to T-junctions without Sunday crashes
3. Severity is proportionally more uniform with equal property damage and medical treatments.
4. The DCA groups are roughly split into three main types and one minor type:
    I. 100 – Intersection, vehicles from adjacent approaches
    II. 200 – Vehicles from opposing directions
    III. 300 – Vehicles from one direction
    IV. 700 – Off path, on straight collision

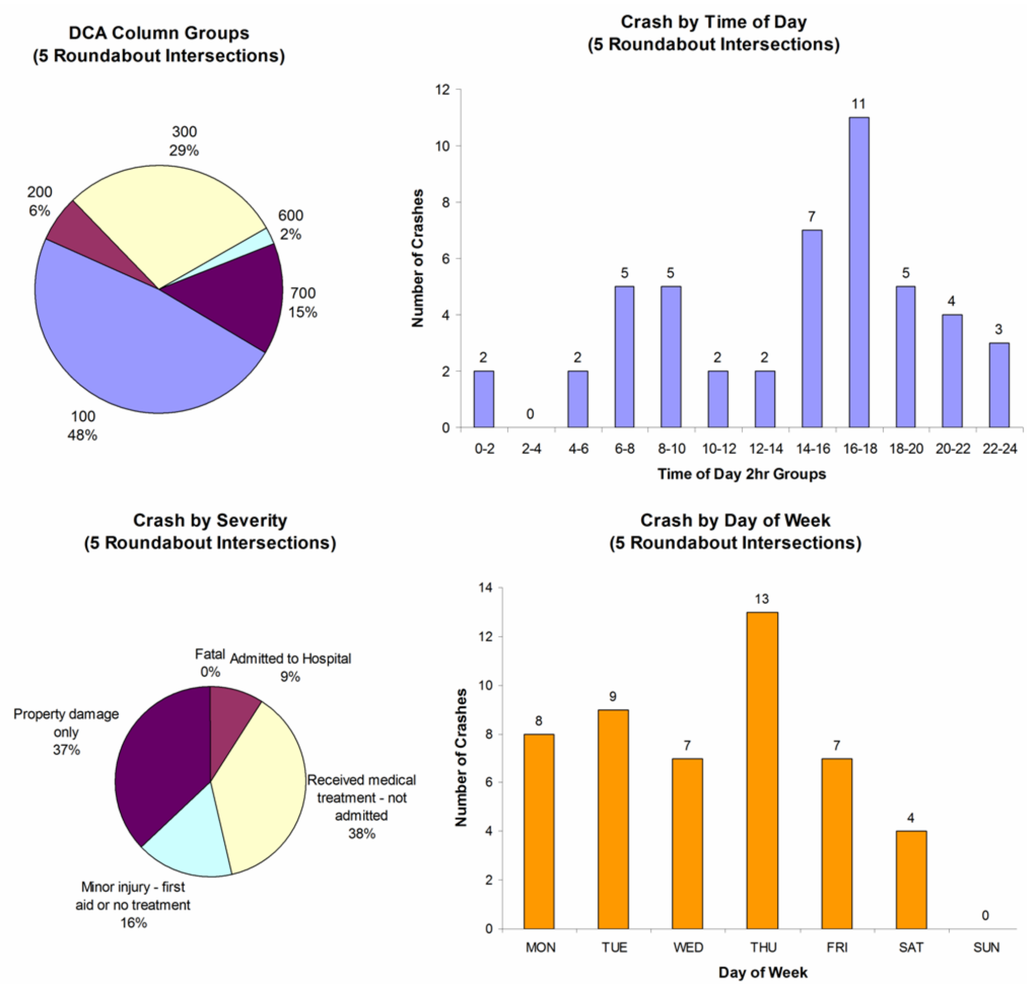


Figure 6-10: Roundabout Intersection (5) All Classifications Graphs

Pure proportional analysis in this case is not enough to come to a conclusion. For example roundabouts are known to have less severe accidents with comparison to cross intersections, due to the low angles of impact. However the inverse appears to be the case between figure 6-10 and figure 6-8, severity graphs.

Table 6-2 overleaf - Intersection Crashes by Traffic Volume, uses the traffic volume data supplied by the TCC. This has been included to get an idea of the crash rates regardless of volumes.

The following main points can be observed from the two right hand columns of this previous table, which are average values.

1. T-junctions have the lowest crash rate, accounting for:
    a. 50% less crashes than cross intersections &
    b. 27% less than roundabouts

2. T-junctions also have the lowest rate of hospitalisation & fatal crashes with:
    a. 70% less severity than cross intersections &
    b. 33% less severity than roundabouts

3. Roundabouts are the next best intersection with:
    a. 32% less crashes than cross intersections &
    b. 55% less severity than cross intersections

Also looking at the individual values, there is little indication that the different classes exhibit a set distinction from one another. Refer to the following examples:

- Generally an “AA+” is a bad intersection, but the lower ranking one if fine.
- The “AL+” is also variable and still dangerous
- The “SSO” appears safer than the other, but a bigger intersection sample size is needed.

Table 6-2: Intersection Crashes by Traffic Volume

Cross Intersections

Class & Rank Intersection	Mil. Veh. per year	Crash Freq per year	5 year number of hosp. & fatal crashes per million vehicles	5 year number of crashes per million veh.
AA+ 15	11.09	4.20	0.09%	1.89%
AA+ 1	8.38	8.00	0.48%	4.78%
AA+ 3	9.71	5.00	0.62%	2.58%
SS+ 35	8.02	2.80	0.12%	1.75%
SS+ 44	10.05	1.80	0.00%	0.90%
AL+ 79	6.01	1.80	0.00%	1.50%
AL+ 12	8.70	4.80	0.34%	2.76%
AL+ 33	6.36	2.60	0.16%	2.04%
AL+ 89	2.60	1.60	1.15%	3.08%
Average	**7.88**	**3.62**	**0.33%**	**2.36%**

T-Junctions

Class & Rank Intersection	Mil. Veh. per year	Crash Freq per year	5 year number of hosp. & fatal crashes per million vehicles	5 year number of crashes per million veh.
ATT 47	6.19	1.20	0.16%	0.97%
LST 65	5.01	1.40	0.20%	1.40%
ALT 94	6.14	1.40	0.16%	1.14%
ATT 28	8.44	2.00	0.00%	1.18%
ALT 94	6.14	1.40	0.00%	1.14%
TOTAL	**6.38**	**1.48**	**0.10%**	**1.17%**

Roundabouts

Class & Rank Intersection	Mil. Veh. per year	Crash Freq per year	5 year number of hosp. & fatal crashes per million vehicles	5 year number of crashes per million veh.
TSO 25	6.72	2.60	0.15%	1.94%
TSO 80	5.74	2.40	0.17%	2.09%
TTO 52	4.94	2.00	0.20%	2.03%
TTO 98	4.19	1.00	0.24%	1.19%
SSO 61	6.16	1.00	0.00%	0.81%
Average	**5.55**	**1.80**	**0.15%**	**1.61%**

Similar general conclusions can be sought from the following table of severities and DCA values, also with traffic volume corrections applied.

Table 6-3: Severity and DCA by Traffic Volume

Cross Intersection

Severity of Injury "SEV_CODE"		Sev. Count. mil. Veh.
1	Fatal	0
2	Admitted to Hospital	2.967
3	Received medical treatment - not admitted	4.104
4	Minor injury - first aid or no treatment	1.276
5	Property damage only	8.754

DCA per mil. Vehicles	
0	0.320
100	6.644
200	6.949
300	5.789
400	0.239
500	0
600	0.100
700	0.785
800	0.103
900	0.333

T-Junctions

Severity of Injury "SEV_CODE"		Sev. Count. mil. Veh.
1	Fatal	0
2	Admitted to Hospital	0.524
3	Received medical treatment - not admitted	0.325
4	Minor injury - first aid or no treatment	0.524
5	Property damage only	1.610

DCA per mil. Vehicles	
0	0.163
100	2.007
200	0.163
300	0.975
400	0
500	0
600	0
700	0.200
800	0
900	0

Roundabouts

Severity of Injury "SEV_CODE"		Sev. Count. mil. Veh.
1	Fatal	0
2	Admitted to Hospital	0.764
3	Received medical treatment - not admitted	1.898
4	Minor injury - first aid or no treatment	1.101
5	Property damage only	2.438

DCA per mil. Vehicles	
0	0
100	4.184
200	0.526
300	2.474
400	0
500	0
600	0.162
700	1.221
800	0
900	0

Table 6-3 reinforces the premise that T-junctions appear the safest intersection type. Intersection types observed here have the following accident classifications (DCA’s in red), now the traffic volume correction applied:

1. Cross Intersections
    a. 100 – Intersection, vehicles from adjacent approaches
    b. 200 – Vehicles from opposing directions
    c. 300 – Vehicles from one direction

2. T-Junctions
    a. 100 – Intersection, vehicles from adjacent approaches
    b. 300 – Vehicles from one direction

3. Roundabouts
    a. 100 – Intersection, vehicles from adjacent approaches
    b. 300 – Vehicles from one direction

In conclusion with the last few pages on aggregate graphs analysis and volume correction tables, T-junctions appear to be safer than roundabouts. As mentioned earlier, T-junctions have slightly more conflict points. Possibly roundabouts are not quite as safe due to a vehicle not fully stopping and checking for other vehicles entering the intersection. Cross intersections are obviously the most unsafe.

The next nine graphs represent a single class of intersection as developed. The readers’ attention should primarily be on the two pie graphs. As seen previously, time of day and day of week vary and may be more influenced geographically and not by intersection class. For example two class “LST” intersections could have different time trends, simply because one is around the corner from a school.

The first graph is of these represents the busiest intersection class Toowoomba has, an Arterial-Arterial - Cross intersection.

The following main observations can be made from the graphs:

- The DCA groups are almost equally split into three main types – 100, 200 & 300.
- Property damage is approximately half, with the remainder of severity being approximately equally proportioned.

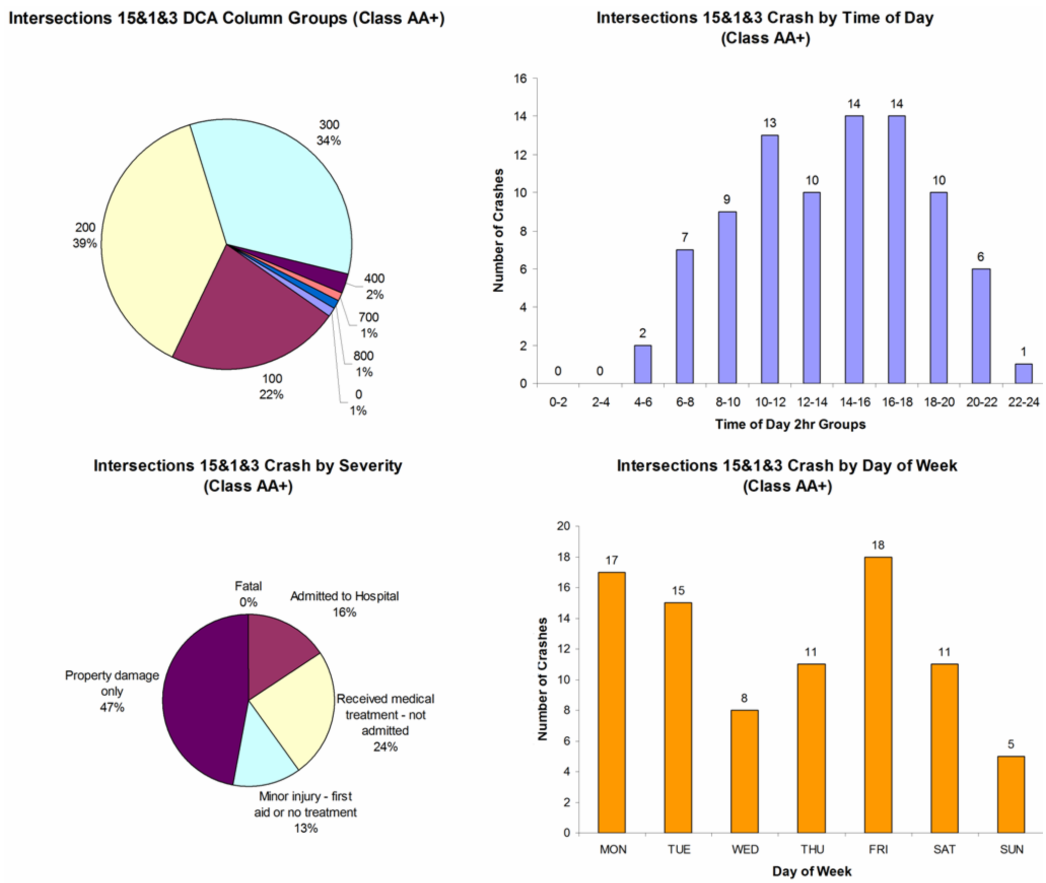


Figure 6-11: Class AA+ (15,1,3) Intersection Graphs

This graph is a SubArterial-SubArterial - Cross intersection class, exhibiting the following main crash characteristics:

- The DCA groups are roughly split into four main types – 100, 200, 300 & 700. The 300 series has reduced dramatically for some reason and replaced with the 700 series.
- Property damage is approximately ¾, with the remainder of severity being approximately equally proportioned, confirming it to be less severe than an "AA+".

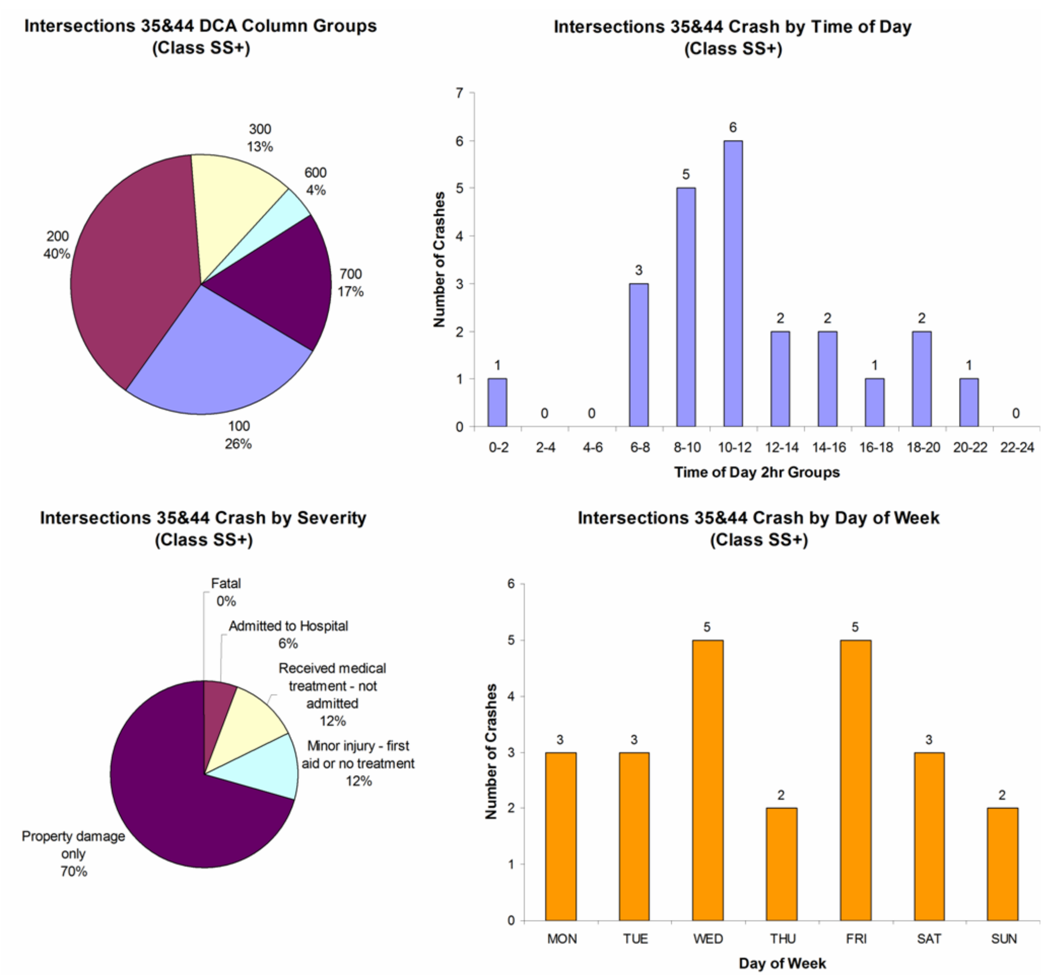


Figure 6-12: Class SS+ (35&44) Intersection Graphs

This graph is a Local-Arterial - Cross intersection class with traffic signs, exhibiting the following main crash characteristics:

- The DCA groups are exactly split into three main types – 100, 200 & 300.
- Property damage is approximately ½, with the remainder of severity being approximately equally proportioned to hospital and medical.

Figure 6-13: Class LA+ (33&89) Intersection Graphs (Signed)

This graph is another Local-Arterial - Cross intersection class, but now with traffic signals exhibiting the following main crash characteristics:

- The DCA groups are varied, introducing a 900 series crash which is a passenger & miscellaneous.
- Property damage is up to approximately ¾ now.

This signalised intersection exhibits a more random crash type with less severity than the simple traffic signed intersection.

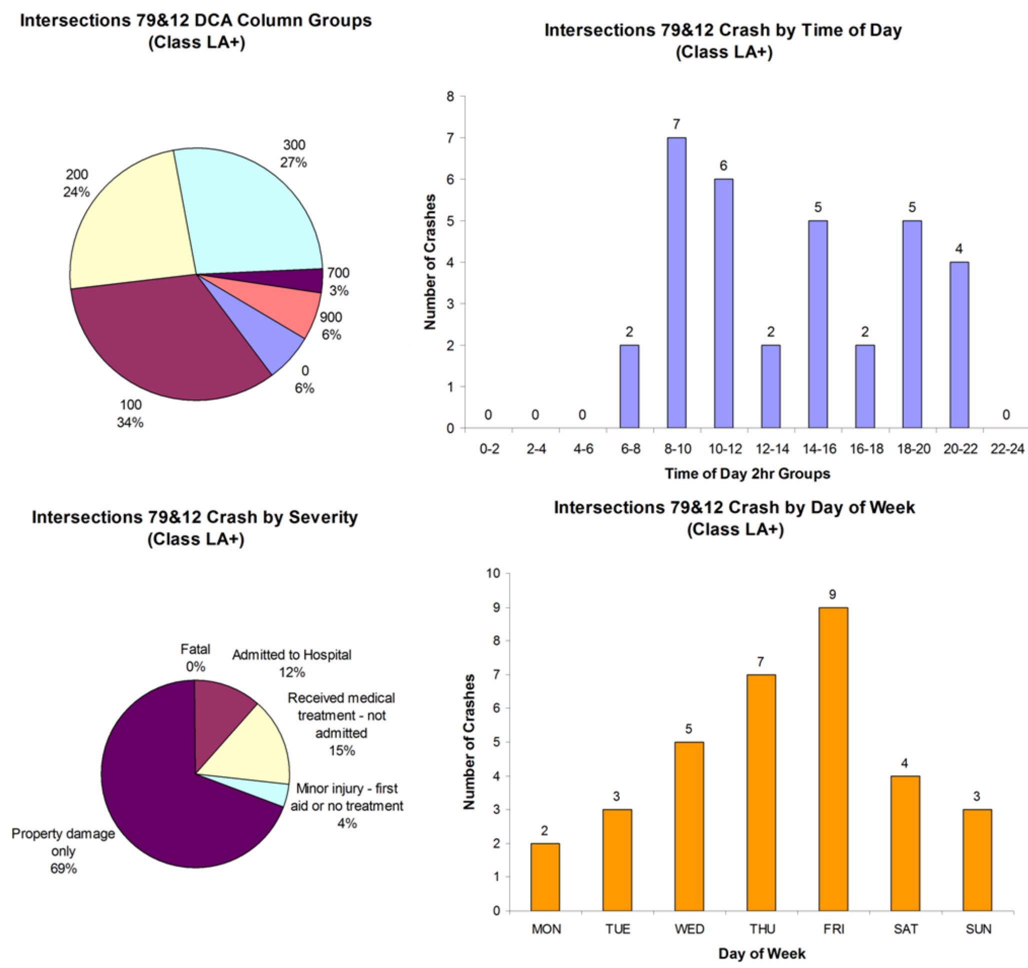


Figure 6-14: Class LA+ (79&12) Intersection Graphs (Signal)

This graph is an Arterial-TrunkCollector – T-junction intersection, exhibiting the following main crash characteristics:

- The DCA group is mainly a 300 series crash and then 100 series.
- Property damage is approximately ½, with the remainder of severity being approximately equally proportioned.

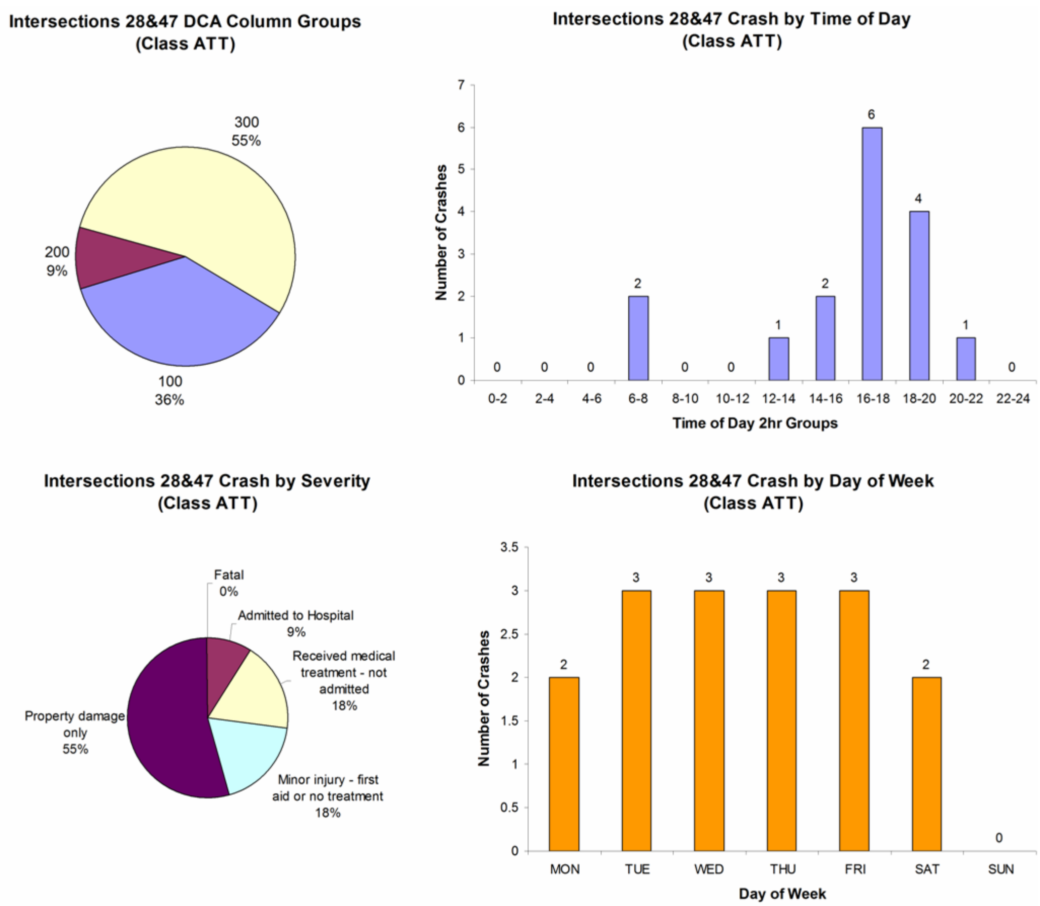


Figure 6-15: Class ATT (28&47) Intersection Graphs

This graph is an Arterial-Local – T-junction intersection, exhibiting the following main crash characteristics:

- The DCA group is mainly a 300 series crash but now the 100 series has shrunk to almost nothing compared with the previous "ATT". The 200 series has swollen here.
- Property damage is still approximately ½, with the remainder of severity being approximately equally proportioned.

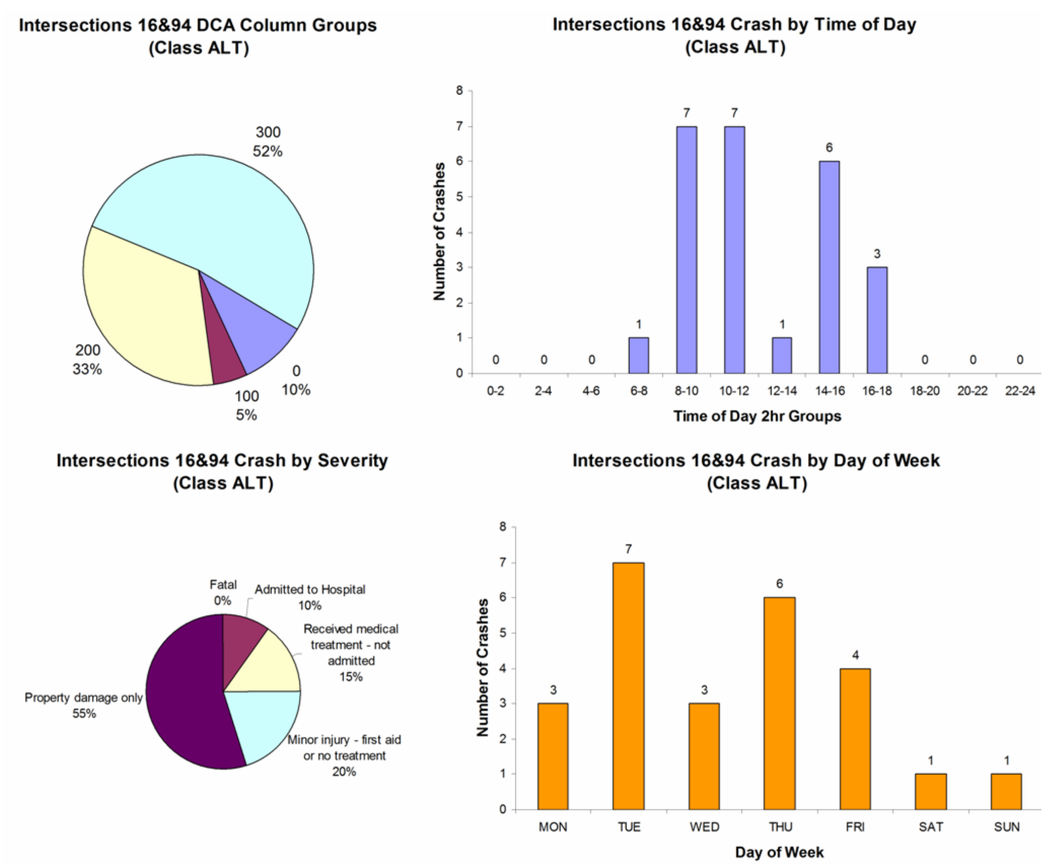


Figure 6-16: Class ALT (16&94) Intersection Graphs

This graph is a Local-SubArterial – T-junction intersection, exhibiting the following main crash characteristics:

- The DCA group is now mainly a 100 series.
- Property damage is approximately ½, with the remainder of severity being approximately equally proportioned.

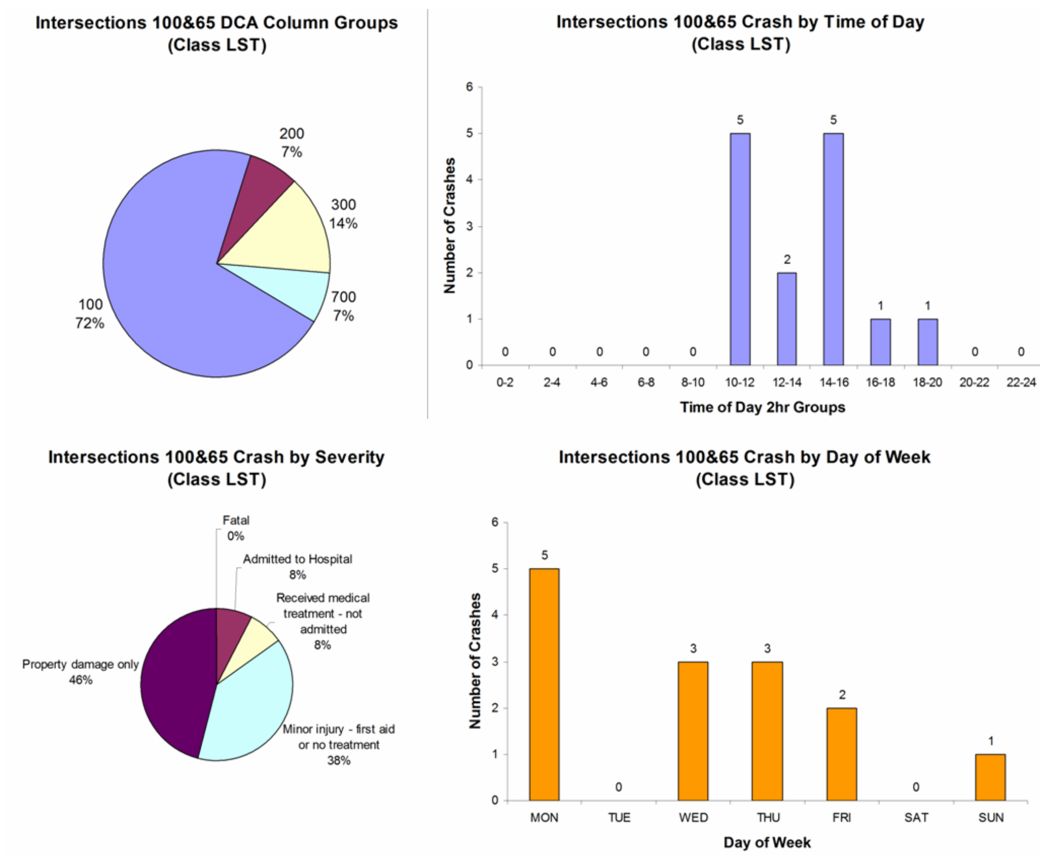


Figure 6-17: Class LST (100&65) Intersection Graphs

This graph is a TrunkCollector-TrunkCollector – Roundabout, exhibiting the following main crash characteristics:

- The DCA group is mainly a 100 with the usual mix of 200, 300 series but with some 700.
- Severity is approximately equally proportioned.

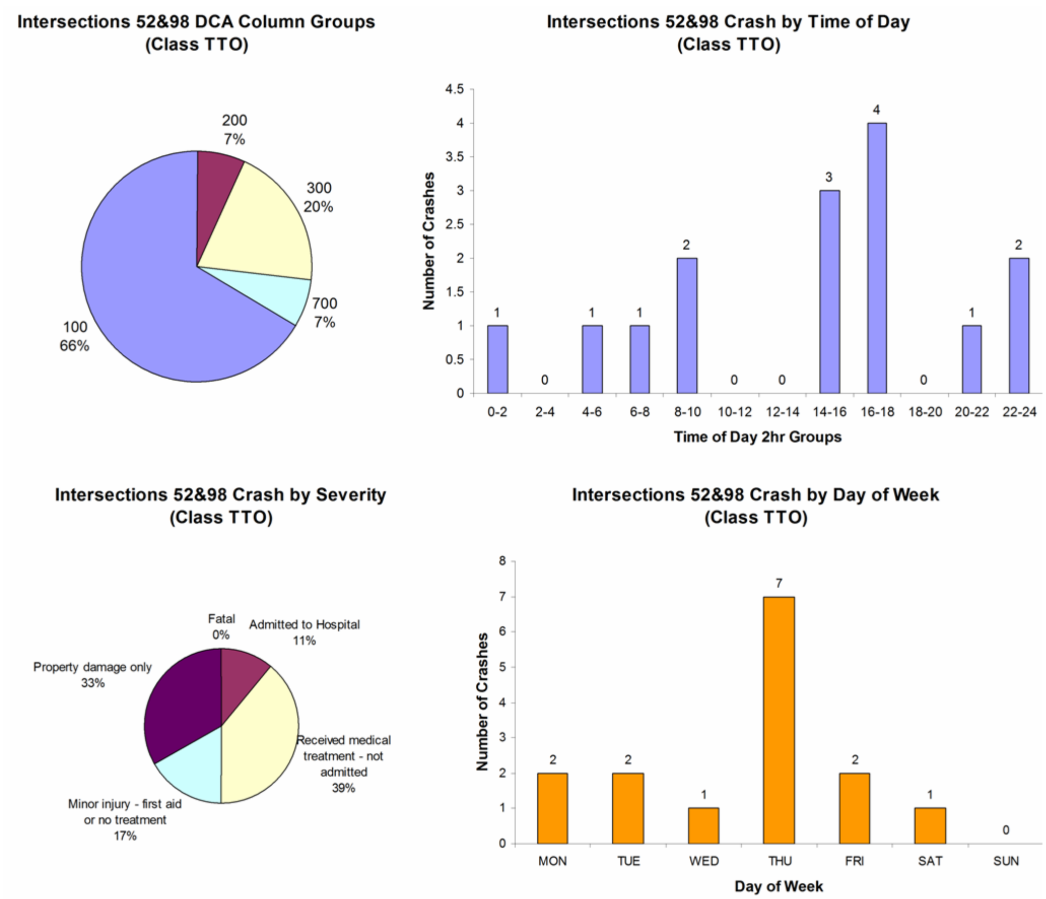


Figure 6-18: Class TTO (52&98) Intersection Graphs

This graph is a TrunkCollector-SubArterial – Roundabout, exhibiting the following main crash characteristics:

- The DCA group is ½ - 100 with 200 & 300 series and now a large 700 series crash.
- Severity is approximately equally proportioned again.

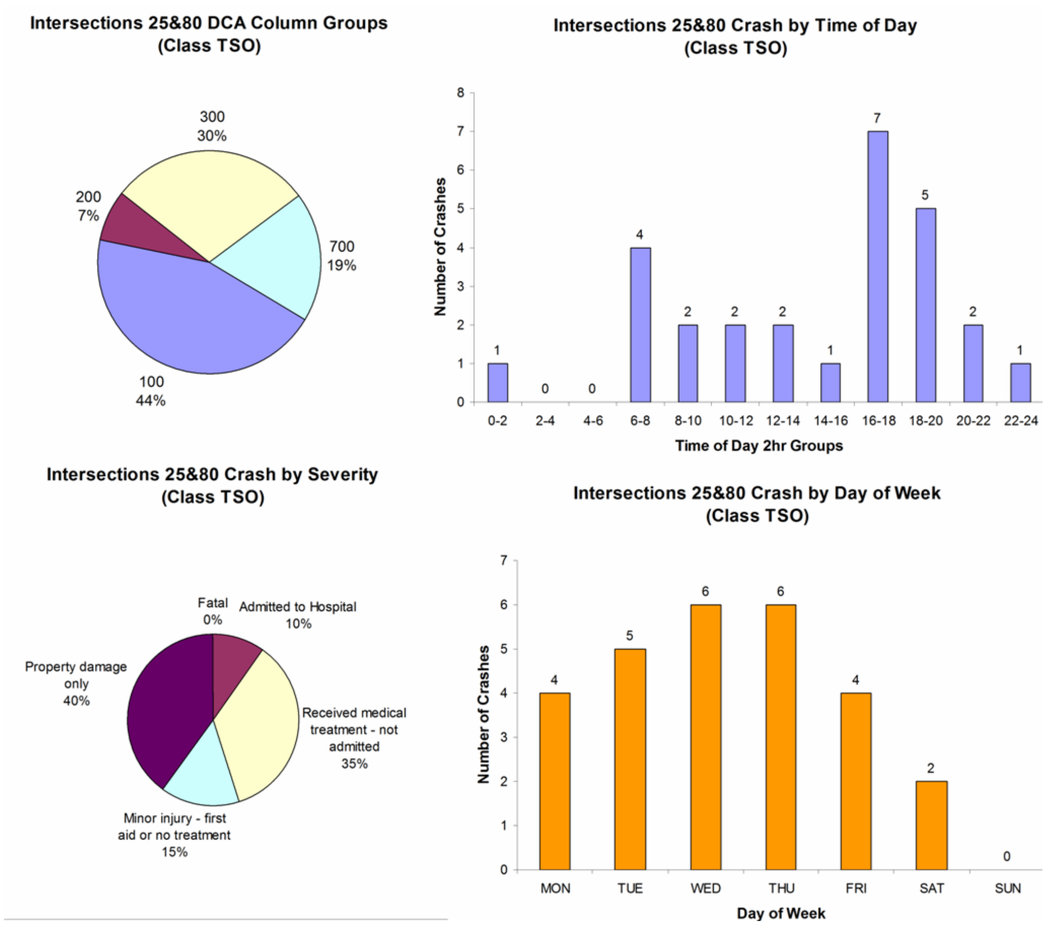


Figure 6-19: Class TSO (25&80) Intersection Graphs

The following conclusions are drawn from the application of the intersection classification system and graphs:

- Crash severity is approximately equally proportioned for roundabouts
- Property damage often approximates to ½ of all other crashes.
- Fatalities are rare
- Lesser order intersections generally have lower severities
- Time of day a crash occurs is somewhat predictable with most crashes occurring in the day when traffic volumes are high, especially peak times.
- The day of week a crash occurs is less understandable. Sundays are relatively crash free, however traffic is lower than weekdays.
- Many DCA codes are not utilised because they are not intersection related collisions.
- The most common crash types are:
    - 100 – Intersection, vehicles from adjacent approaches
    - 200 – Vehicles from opposing directions
    - 300 – Vehicles from one direction

The graphs seem highly variable and contain anomalies that are difficult to explain. There is a need for more crash data to increase reliability and consistency, which may not be possible in Toowoomba.

6.5 Application of Remedial Methods

With the high variability of intersection characteristics and the apparent randomness of this intersection classification system, remedial treatments are best left as a case by case basis. Each intersection treatment should be considered on an individual basis, using the best and most cost-effective remedial treatments known.

Austroads (2004) is a good source of such information, although they flag the following DCA codes for which no remedial treatment can be applied:

000, 200, 300, 400, 500, 600, 700, 800, 900, 901, 906, 907, 403, 405, 606, 607, 610

This is because these crashes are unlikely to be attributable to a road environment factor.

The Department of Main Roads staff stated possibly the most effective and relatively cheap remedial treatment for intersection crashes in Toowoomba would be upgrading intersection traffic signals. In particular introducing dedicated right-hand turning arrows to intersections where such movements are up to the driver to pick a gap in which to turn.

7 Recommendations & Findings

This chapter is a brief discussion on the main findings of this project and some possible recommendations. Crash data problems are discussed and intersections classification issues. Outcomes of the application of the classification system are outlined on the previous page.

7.1 Crash Data Problems

Like all data to some extent, both the TCC and DMR crash databases had their own errors and omissions. Both sets of crash data received were both virtually complete and mostly error free.

Both sets of data originating from the same source should ensure their consistence, however the crash data generation difference causes the two data sets to be very dissimilar in format, extent of content and currency. This can be seen by viewing the samples of each in the appendices.

Some errors and/or & faulty data includes:

- Neither crash data contained atmospheric light condition data, only the crash times were present.
- DMR data only supplies the hour the crash occurred.
- TCC data was very limited, in particular having no weather conditions with the crash records. DMR seemed to not have very many wet weather crashes, suspecting under reporting in this area.
- Some duplicate crash data entries were found.
- Unique crash ID numbers are compiled differently between TCC or DMR databases
- Some unique crash ID numbers were missing
- Some crash entries were in one database but not the other.

Possible reasons were highlighted for crash data not showing up in the other TCC or DMR database.

1. Often DMR deemed it not to be an intersection crash, assigning it a 99 (Not Applicable) instead.
2. Data was lost when entered into a computer or simply lost.
3. Unique crash ID's structured differently and/or digits some missing
4. DMR may under report some minor crashes.

An example of possibly flawed crash data occurred at the intersection of HURSLEY RD & McDOUGALL ST (Rank26), classified Sub-Arterial- Sub-Arterial.Roundabout (SSO). There were only four crashes in five years, all in 2002 within a few months of each other. This intersection was removed from the study.

Some examples are shown below with their respective incident numbers of several duplicate crash data entries that were discovered in the TCC crash database,.

- ANZAC AVE & CANNING ST 04/30195.
- ALDERLEY ST & MACKENZIE ST 02/8227
- GLENVALE RD & GREENWATTLE ST 02/5374

This problem of duplicate crash entries was relatively rare and could easily be identified, and one of the pair deleted.

A problem existed with the "SEV_CODE" (severity) field in the DMR data which was used in analysis and charting. The reason was related to the DMR database failing to have an entry for the particular crash when TCC did. The TCC data displayed number of killed or injured only. Like most other data omissions, it could be solved by viewing the original police crash report if available.

The DMR severity code could be inferred from the TCC "KILLED" and "INJURED" fields for the corresponding crash. This should be possible if the accident was a fatality, as it had a clear case of yes or no. However for an injury having varying levels of severity, it isn't so clear.

By comparing the two different severity ratings of either database, it became evident that a TCC “INJURED” entry was either a DMR severity code 2, 3 or 4.

2. Admitted to Hospital
3. Received medical treatment - not admitted
4. Minor injury - first aid or no treatment

The accident severity analysis and charts do not reflect the actual crash situation fully.

1 Fatal

2Admitted to Hospital

5 Property damage only

To make matters worse 35% of the TCC data did not have an incident number assigned to them.

The following recommendations are a guide only, dependant on the needs of the two road authorities in question.

It is recommended that TCC source their crash data from the Road/Web Crash system in the same manner DMR do, dependant on cost obviously. Although TCC may not need full compatibility with DMR data nor need to do much data analysis requiring all the extra data fields, money would be saved in the form of data entry costs.
However both parties feel some minor crashes are omitted from Road/Web Crash system, which should be proven first.

As part of TCC possibly changing to a better system, it is also recommended that TCC change from their RUM accident coding system to the Austroads widely recognised system, DCA codes.

7.2 Intersection Classification Problems

With most intersections being “cross” configuration, there were not enough intersections in each class to compare. From the TCC top 100 intersections and 40 class combinations, only 21 classes had intersections in them. With many intersection classes not having sufficient intersections in which to compare, worst off were the Y-junctions and Multi-intersections, which only 2 eligible intersections.

This is the primary cause for doubt of intersection classification validity, and subsequent thought into development of a better system. This situation may also be partially remedied with the classification of the TCC top 300 intersections or more, but this could introduce more intersections with limited crash numbers.

Hierarchy is a great choice for the classification system, however it relies town planning staff to determine what it is. Maybe the hierarchy is a target of hierarchy designation to be achieved but not there yet. The hierarchy may also be out of date and need revising.

More trouble occurred when applying the road hierarchy, when the hierarchy changed along the road length at intersections. The higher hierarchy was applied in this case.

Some trouble with the intersection classification system code occurred whilst using the spreadsheet. The hierarchy letter order was recognised by the spreadsheet as two different classes. For example a code TA+ intersection is equivalent to an AT+. This equivalence is not that easy to spot when amongst many other intersections classed.

A few geometric intersection issues are present with classification such as:

- Varying leg traffic volumes at intersections, e.g. bridge & tor
- Intersection legs at angles could influence behaviour
- Closely adjoining T-junction intersections may influence the crash situation at the other T-junction.

8 Conclusions

8.1 Summary of Investigation Method

The method of this crash investigation in Toowoomba is broken up into the major parts as shown below:

1. Crash data acquisition
2. Preliminary data comparisons
3. Crash data preparation
4. Exclusion of all data outside project scope
    a. Non-Intersection data
    b. Crashes outside of Toowoomba area
    c. Data outside specified 5 year time frame
5. Scope narrowed to TCC top 100 worst intersections
6. Toowoomba wide characteristics of crashes analysis
7. Identify intersection to classify
8. Intersection classification system application
9. Select intersections groups to analyse
10. Remove intersections with major works within the specified 5 year period.
11. DMR & TCC Data Merged
12. Grouping and comparison of intersections
13. Carry out an analysis of the crash data, specifically looking at:
    a. Data anomalies
    b. Trends in dates, wet roads, directions and vehicle types
    c. Charting of DCA, time of the day, day of the week and severity
14. Compare trends with classification groups and conclude

8.2 Recommendations of Further Work

If someone were searching for a similar project in which to go on with, the following suggestions would form a good starting point.

The worth of an intersection classification system requires additional study. Further develop the intersection classifications system. This could possibly be conducted with the refinement of system by eliminating classification combinations. The introduction of a scoring system would follow based on road hierarchy, and possibly the number of intersection conflict points. This alternate classification system suggestion has been partially started.

Establish a benchmark average crash rate for each intersection class. This could allow intersections to be compared to this benchmark to determine if the crash rate is high for the certain class of intersection.

Obtain a much larger crash data set to work with. This would allow a lot more intersections to be created in each class for comparison. This could be achieved with crash data from Brisbane, but would require more spreadsheet automation to be time efficient. Taking more intersections (e.g. the top 300) will yield more in each class, but each intersection will have less crash entries to analyse.

Further investigate the validity of applying remedial methods to intersection classes. Investigate intersections characteristics more actively. This could be conducted by comparing the best and worst intersections in a class and determining the main reasons or features that create such a low or high crash rate. However if the crash rate is very different, the classification of the two may not be valid.

8.3 Project Conclusion

This project only partially achieved the project objectives acceptably, due to the high variability of intersection characteristics and the apparent randomness of the graphs produced. The intersection classification system was developed successfully but requires refinement.

A crash investigation such as this is difficult to do with such a broad scope. There were several areas in this project were the scope had to be narrowed.

The original main aim of determining remedial methods for intersections proved to be only a valid in a broad sense. Remedial methods are well documented for certain crash types and require in-depth analysis of the particular intersection, not an area wide analysis. Each intersection remedial treatment should be considered on an individual basis, using the best and most cost-effective remedial treatments known.

The validity of this crash investigation concludes that it is not only the accuracy of the data and correct analysis techniques but also how well the intersection classification system fits, to “compare like intersections”.

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Appendix A – Original Project Specification

A

UNIVERSITY OF SOUTHERN QUEENSLAND
FACULTY OF ENGINEERING AND SURVEYING

ENG4111/ENG4112 RESEARCH PROJECT

PROJECT SPECIFICATION

Student: Clayton Sharp

Project Topic: Investigation of Toowoomba Intersection Crashes

Supervisor: Associate Professor Ron Ayers (USQ)

Adam Currie, Department of Main Roads, Queensland

Aim

To identify intersection treatments that may be used with a high likelihood of success in reducing crash rates, at particular types of intersections in Toowoomba.

Background

A high proportion of road traffic crashes in Toowoomba occur at intersections. This project will need to firstly develop an intersection classification system which will enable the grouping of intersections with similar characteristics. The grouping system will then be used to group Toowoomba crash data for further analysis. The further analysis should enable the determination of whether or not particular remedial treatments result in reduced crash rates.

Program

1. Review existing literature from Australia and overseas, with particular regard to:
   - Intersection crash frequency and causes;
   - Classification systems for urban intersections used in crash data analysis;
   - Urban intersection crash analysis studies; and
   - Remedial treatments for intersections with high crash rates.

2. Develop and apply a simple intersection classification system which will allow the analysis of intersection crash data by intersection type. Finalisation of the system should occur after consultation with staff from Queensland Transport, Department of Main Roads and Toowoomba City Council.

3. For several categories of intersection, carry out an analysis of the crash data to try and determine if certain types of treatments (e.g. roundabouts, traffic signals) result in lower crash rates.

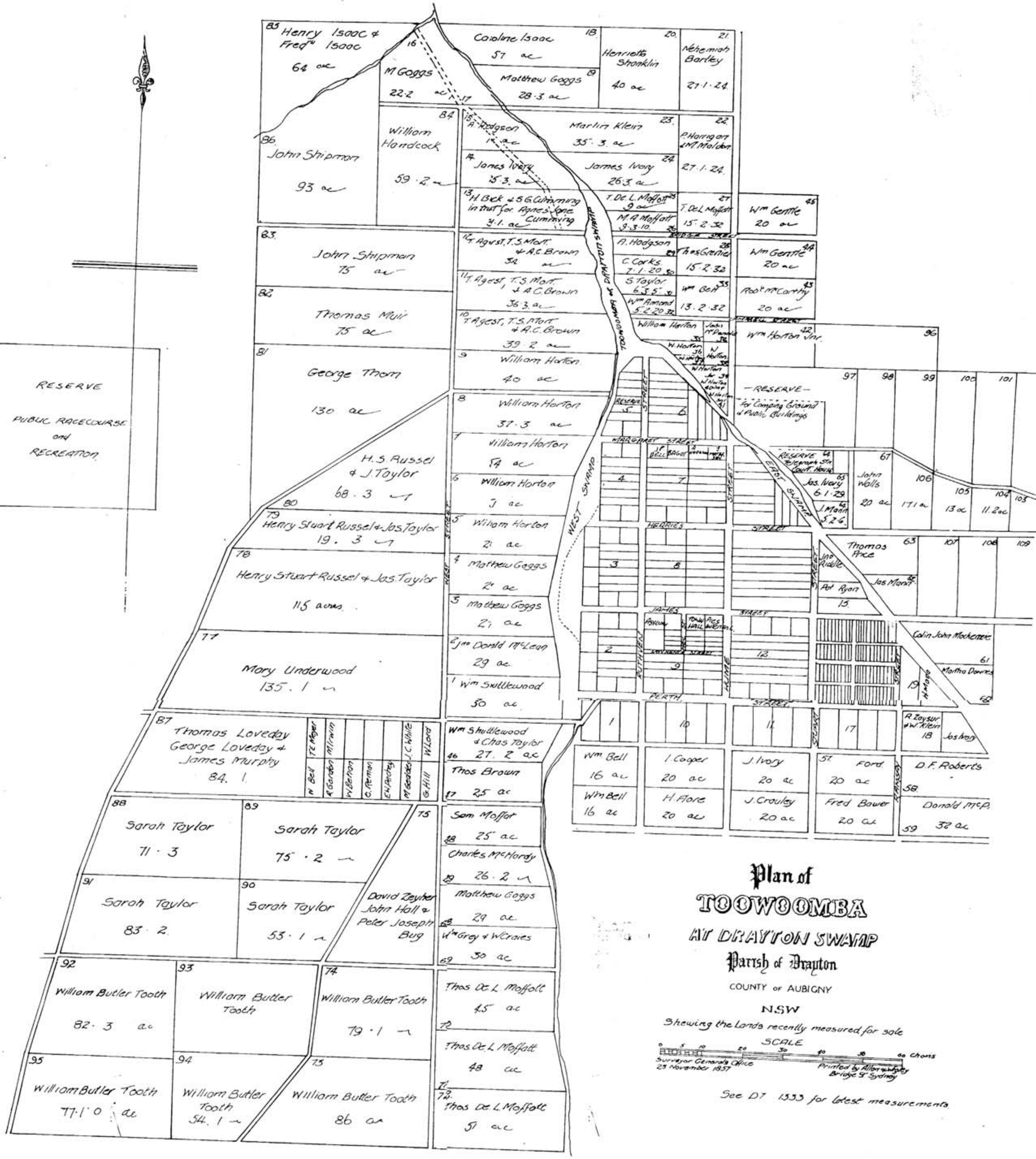
4. Report findings and developed strategy though oral presentation at the project conference and in the required written format.

R.A. Ayers.
....
R. Ayers
Date 28/3/06

C. Sharp.
....
C. Sharp
Date 28/3/06

Appendix B - 1957 Survey Plan of Toowoomba at Drayton Swamp

B



Plan of
TOOWOOMBA
AT DRAYTON SWAMP
Parish of Drayton
COUNTY of AUBIGNY
N.S.W
Shewing the Lands recently measured for sale
SCALE
Surveyor General's Office 23 November 1857
Printed by Allan & Wigley Bridge St Sydney
See D7 1333 for latest measurements
RESERVE
PUBLIC RACECOURSE and RECREATION
Henry Isaac & Fredk Isaac 64 ac
Caroline Isaac 57 ac
Henrietta Shanklin 40 ac
Nehemiah Bartley 27.1.24
M Goggs 22.2 ac
Matthew Goggs 28.3 ac
John Shipman 93 ac
William Handcock 59.2
A. Hodgson
Martin Klein 35.3 ac
James Ivory 15.3
James Ivory 26.3 ac
H. Bick & S.G. Cumming in trust for Agnes Jane Cumming 3.1 ac
John Shipman 75 ac
Thomas Muir 75 ac
George Thorn 130 ac
H.S. Russel & J. Taylor 68.3
Henry Stuart Russel & Jas Taylor 19.3
Henry Stuart Russel & Jas Taylor 115 acres
Mary Underwood 135.1
Thomas Loveday George Loveday & James Murphy 84.1
Sarah Taylor 71.3
Sarah Taylor 75.2
Sarah Taylor 83.2
Sarah Taylor 53.1
David Zeyher John Hall & Peter Joseph Bug
William Butler Tooth 82.3 ac
William Butler Tooth
William Butler Tooth 79.1
William Butler Tooth 77.1.0 ac
William Butler Tooth 54.1
William Butler Tooth 86 ac
William Horton 40 ac
William Horton 37.3 ac
William Horton 54 ac
William Horton 7 ac
William Horton 21 ac
Matthew Goggs 2 ac
Mathew Goggs 21 ac
Jno Donald McLean 29 ac
Wm Skillewood 30 ac
Wm Shuttlewood & Chas Taylor 27.2 ac
Thos Brown 25 ac
Sam Moffat 25 ac
Charles McHardy 26.2
Matthew Goggs 29 ac
Wm Grey & W Crates 30 ac
Thos De L. Moffatt 45 ac
Thos De L. Moffatt 48 ac
Thos De L. Moffatt 51 ac
TOOWOOMBA or DRAYTON SWAMP
WEST SWAMP
EAST SWAMP
MARGARET STREET
HERRIES STREET
JAMES STREET
PERTH STREET
RUTHVEN STREET
HUME STREET
RESERVE for Camping Ground & Public Buildings
Wm Gentle 20 ac
Robt McCarthy 20 ac
Wm Horton Jnr.
Thomas Price
John Walls 20 ac
Colin John Mackenzie
Martha Downes
Wm Bell 16 ac
I. Cooper 20 ac
J. Ivory 20 ac
Ford 20 ac
D.F. Roberts
Wm Bell 16 ac
H. Flore 20 ac
J. Crouley 20 ac
Fred Bower 20 ac
Donald McP. 32 ac

Appendix C – TCC sample Data Received

C

ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
21/11/1996	18:25	CLIFFORD ST	GRANGE ST	0	0	60E
30/09/1996	13:15	BRIDGE ST	RUTHVEN ST	0	0	32N
30/11/1996	19:15	GLENVALE RD	GREENWATTLE ST	0	0	10N
22/12/1996		McDOUGALL ST	TAYLOR ST	0	0	10E
1/12/1996		JAMES ST	WEST ST	0	0	21S
1/12/1996		HURSLEY RD	TOR ST	0	0	21E
16/10/1996	10:00	JAMES ST	150m E WEST	0	0	47S
24/11/1996	15:40	BARRABOOL ST	TAYLOR ST	0	0	19-
1/10/1996	7:50	JELLICOE ST	RUTHVEN ST	0	1	10E
31/10/1996	9:55	CARROLL ST	INDUSTRIAL AVE	0	1	21W
25/10/1996	16:00	HURSLEY RD	at No 59	0	1	00N
23/11/1996	15:00	JAMES ST	20m E KITCHENER ST	0	0	30E
4/11/1996	16:15	GEDDES ST	JAMES ST	0	2	10N
2/11/1996	19:29	McDOUGALL ST	TAYLOR ST	0	0	10E
25/11/1996	5:30	DRAYTON RD	STENNER ST	0	1	10E
4/12/1996	16:45	TOR ST	VICTORY ST	0	0	32N
27/10/1996	19:20	GIPPS ST	O/S No 88	0	1	09-
9/11/1996	14:45	FLINDERS ST	RAMSAY ST	0	0	33S
23/11/1996	11:40	ANZAC AVE	JAMES ST	0	0	32N
6/12/1996		CORTESS ST	HOEY ST	0	1	10S
25/09/1996	10:15	LUCK ST	WATTS ST	0	1	21S
28/11/1996	17:15	HERRIES ST	WEST ST	0	0	31W
9/11/1996	10:45	MACKENZIE ST	O/S No 72	0	0	71S
5/12/1996	15:00	TOR ST	50m S HURSLEY	0	0	30S
10/12/1996		BOXSALL ST	TAYLOR ST	0	1	48N
15/10/1996	12:10	GLENVALE RD	GREENWATTLE ST	0	0	10N
27/10/1996		ALDERLEY ST	BAIRD ST	0	0	40W
20/11/1996	20:00	BOUNDARY ST	TAYLOR ST	0	0	60S
14/11/1996	10:45	ALDERLEY ST	BLACKBURN ST	0	0	60W
6/10/1988	0:00	LONG ST	RUTHVEN ST	0	0	21S
19/12/1987	0:00	ANZAC AVE	VACY ST	0	0	30N
5/03/1988	0:00	JAMES ST	WEST ST	0	0	21S
20/01/1988	0:00	LITTLE ST	W of DUGGAN ST	0	0	60E
4/11/1988	0:00	MARGARET ST	MARY ST	0	0	10W
9/07/1988	0:05	GOOMBUNGEE RD	200m NW CRANLEY	0	0	84S
14/07/1988	0:07	BUCKLAND ST	YALDWYN ST	0	0	10W
17/04/1988	0:08	HUME ST	MURRAY ST	0	1	71N
13/08/1988	0:10	JAMES ST	PHILLIP ST	0	0	10N
25/07/1988	0:10	JAMES ST	CLIFFORD GARD	0	0	64E
11/09/1988	0:15	GORDON AVE	SIMON ST	0	0	75E

RUMDESC	INCID_NO	INT	COUNCIL	CLASS	Accident
ON PATH HIT PARKED VEHICLE EASTBOUND	96/27504	TRUE	TRUE	L130	TRUE
VEHICLES FROM SAME DIRECTION REAR END FRONT VEH TURNING RT S-E	96/25459	TRUE	FALSE	ART	TRUE
AT INTERSECTION CROSS TRAFFIC NORTHBOUND - WESTBOUND	96/28288	TRUE	TRUE	L260	TRUE
AT INTERSECTION CROSS TRAFFIC NORTHBOUND - EASTBOUND		TRUE	TRUE	SUB-ART	TRUE
VEHICLES FROM OPPOSING DIRECTIONS RIGHT-TURN FROM N - STR FROM	96/27223	TRUE	FALSE	ART	TRUE
VEHICLES FROM OPPOSING DIRECTIONS RIGHT-TURN FROM W - STR	96/27579	TRUE	FALSE	ART	TRUE
EMERGING FROM DRIVEWAY ONTO EASTBOUND CARRIAGEWAY	96/24453	FALSE	FALSE	ART	TRUE
AT INTERSECTION OTHER FROM ADJACENT ROADS		TRUE	FALSE	SUB-ART	TRUE
AT INTERSECTION CROSS TRAFFIC NORTHBOUND - EASTBOUND	96/24013	TRUE	FALSE	ART	TRUE
VEHICLES FROM OPPOSING DIRECTIONS RIGHT-TURN FROM E - STR FROM	96/25736	TRUE	TRUE	L140	TRUE
PEDESTRIAN near side eastbound	96/25311	FALSE	FALSE	COLL	TRUE
VEHICLES FROM SAME DIRECTION REAR END EASTBOUND	96/27679	FALSE	FALSE	ART	TRUE
AT INTERSECTION CROSS TRAFFIC NORTHBOUND - WESTBOUND	96/26069	TRUE	TRUE	ART	TRUE
AT INTERSECTION CROSS TRAFFIC NORTHBOUND - EASTBOUND	96/25957	TRUE	TRUE	SUB-ART	TRUE
AT INTERSECTION CROSS TRAFFIC NORTHBOUND - EASTBOUND	96/27807	TRUE	TRUE	COLL	TRUE
VEHICLES FROM SAME DIRECTION REAR END FRONT VEH TURNING RT S-E	96/28616	TRUE	FALSE	ART	TRUE
OTHER PEDESTRIAN	96/25427	FALSE	FALSE	SUB-ART	TRUE
VEHICLES FROM SAME DIRECTION LANE SIDE SWIPE SOUTHBOUND	96/28044	TRUE	TRUE	COLL	TRUE
VEHICLES FROM SAME DIRECTION REAR END FRONT VEH TURNING RT S-E	96/27656	TRUE	TRUE	ART	TRUE
AT INTERSECTION CROSS TRAFFIC SOUTHBOUND - EASTBOUND	96/28667	TRUE	TRUE	L430	TRUE
VEHICLES FROM OPPOSING DIRECTIONS RIGHT-TURN FROM N - STR FROM	96/22666	TRUE	FALSE	L480	TRUE
VEHICLES FROM SAME DIRECTION REAR END FRONT VEH TURNING LEFT	96/28373	TRUE	TRUE	SUB-ART	TRUE
STRAIGHT OFF CARRIAGEWAY TO LEFT INTO OBJECT/PARKED VEH	96/26513	FALSE	TRUE	L130	TRUE
VEHICLES FROM SAME DIRECTION REAR END SOUTHBOUND	96/28692	FALSE	FALSE	ART	TRUE
FROM FOOTPATH ONTO NORTHBOUND CARRIAGEWAY	96/27687	TRUE	FALSE	SUB-ART	TRUE
AT INTERSECTION CROSS TRAFFIC NORTHBOUND - WESTBOUND	96/24382	TRUE	TRUE	L260	TRUE
MANOEUVRING U-TURN E-E COLLISION WITH MOVING VEHICLE	96/25424	TRUE	TRUE	COLL	TRUE
ON PATH HIT PARKED VEHICLE SOUTHBOUND	96/27418	TRUE	TRUE	SUB-ART	TRUE
ON PATH HIT PARKED VEHICLE WESTBOUND	96/26880	TRUE	TRUE	L390	TRUE
VEHICLES FROM OPPOSING DIRECTIONS RIGHT-TURN FROM N - STR FROM		TRUE	FALSE	ART	TRUE
VEHICLES FROM SAME DIRECTION REAR END NORTHBOUND		TRUE	TRUE	SUB-ART	TRUE
VEHICLES FROM OPPOSING DIRECTIONS RIGHT-TURN FROM N - STR FROM		TRUE	FALSE	ART	TRUE
ON PATH HIT PARKED VEHICLE EASTBOUND		FALSE	TRUE	L680	TRUE
AT INTERSECTION CROSS TRAFFIC SOUTHBOUND - WESTBOUND		TRUE	TRUE	COLL	TRUE
CURVE OFF C'WAY TO RIGHT ON LEFT BEND EASTBOUND		FALSE	TRUE	L020	TRUE
AT INTERSECTION CROSS TRAFFIC SOUTHBOUND - WESTBOUND		TRUE	TRUE	L330	TRUE
STRAIGHT OFF CARRIAGEWAY TO LEFT INTO OBJECT/PARKED VEH		TRUE	TRUE	COLL	TRUE
AT INTERSECTION CROSS TRAFFIC NORTHBOUND - WESTBOUND		TRUE	FALSE	ART	TRUE
ON PATH PERMANENT OBSTRUCTION ON CARRIAGEWAY EASTBOUND		TRUE	FALSE	ART	TRUE
STRAIGHT OFF END OF ROAD/TEE INTERSECTION EASTBOUND		TRUE	TRUE	L080	TRUE

NOTES: 00-04 RANKING sort criteria: PRIMARY SORT - Total (00-04); SECONDARY SORT - AADT
" 00-04 Rank" is based on new AADT figures calculated from data supplied by Main Roads (July 2004) and using a AADT calibration factor of 1.23 All previous 5 year periods sorted on new data.

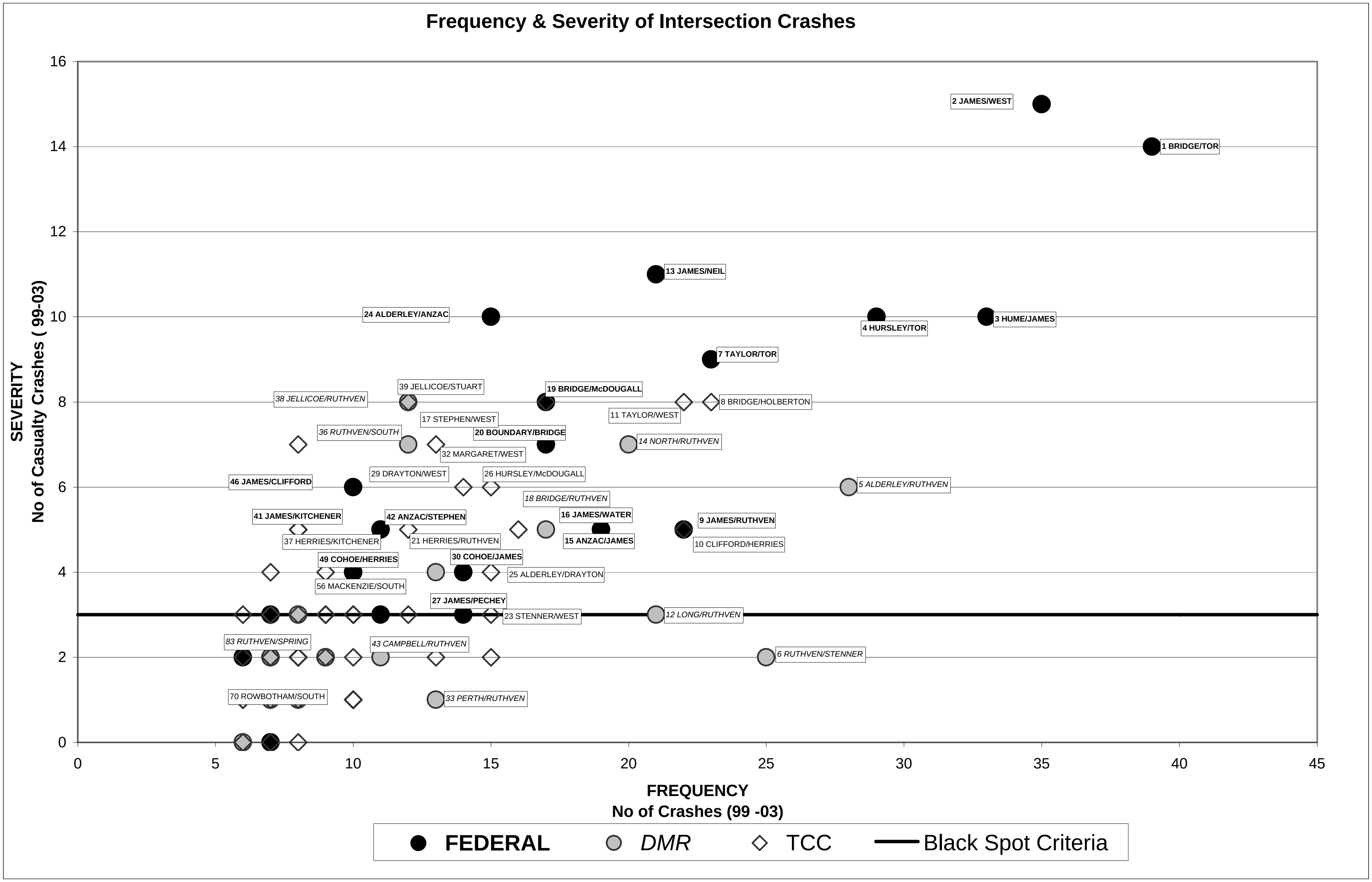
RANKING				*Data was initially limited to intersections with 4 or more accidents since 1987 (from the Accident Database)*								ANNUAL CRASH DATA								
												332	308	343	325	321	332	357	392	138
96-00 CRASH RANK	97-01 CRASH RANK	98-02 CRASH RANK	99-03 CRASH RANK	MAJOR STREET	MINOR STREET	OWNER	control	LAST TREATMENT DATE	INTERSECTION TREATMENT	INV STATUS	UNIQUE IDENTIFIER (GIS - See Matthew Andretta)	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	1	1	1	BRIDGE ST	TOR ST	FED	signals	1998	TRAFFIC LIGHTS MODIFIED	Investigate	497	8	5	7	7	7	10	11	4	10
4	3	2	2	JAMES ST	WEST ST	FED	signals	Mar-97	TRAFFIC LIGHTS MODIFIED	Investigate	1277	8	3	4	7	5	9	7	7	9
5	4	3	3	HUME ST	JAMES ST	FED	signals	Nov-76	TRAFFIC LIGHTS INSTALLED	Planning	1339	4	0	8	9	6	1	8	9	6
13	6	7	4	HURSLEY RD	TOR ST	FED	signals	Nov-90	TRAFFIC LIGHTS INSTALLED	Investigate	1036	1	2	5	5	5	6	3	10	6
10	5	5	5	ALDERLEY ST	RUTHVEN ST	DMR	signals	Jul-04	TRAFFIC LIGHTS MOD - RIGHT TURNS ALDERLEY ST	Planning	1788	3	3	5	4	5	7	5	7	3
2	2	4	6	RUTHVEN ST	STENNER ST	DMR	signals	Apr-99	TRAFFIC LIGHTS & CHANNELISATION MODIFIED	Investigate	2092	7	7	9	2	6	5	5	7	7
3	8	8	7	TAYLOR ST	TOR ST	FED	signals	Apr-98	TRAFFIC LIGHTS MODIFIED	Investigate	740	8	4	5	6	6	2	5	4	6
6	9	6	8	BRIDGE ST	HOLBERTON ST	TCC	signals	Jun-01	TRAFFIC LIGHTS MODIFIED	Monitor	545	3	3	6	7	5	2	5	4	2
23	16	16	9	JAMES ST	RUTHVEN ST	FED	signals	Nov-98	TRAFFIC LIGHTS MODIFIED	Monitor	1323	2	2	3	3	4	4	3	8	5
22	13	14	10	CLIFFORD ST	HERRIES ST	TCC	signals	Sep-96	TRAFFIC LIGHTS MODIFIED	Planning	1123	1	3	1	6	4	5	3	4	3
12	11	10	11	TAYLOR ST	WEST ST	TCC	signals	Aug-72	TRAFFIC LIGHTS INSTALLED	Investigate	819	4	6	1	4	4	5	9	0	1
11	12	12	12	LONG ST	RUTHVEN ST	DMR	signals	Mar-85	TRAFFIC LIGHTS INSTALLED	Investigate	1500	3	4	5	4	4	2	5	6	8
14	30	17	13	JAMES ST	NEIL ST	FED	signals	Mar-77	TRAFFIC LIGHTS INSTALLED	Investigate	1330	5	1	2	5	5	0	5	7	4
67	31	22	14	NORTH ST	RUTHVEN ST	DMR	signals	Nov-84	TRAFFIC LIGHTS INSTALLED	Planning	342	1	3	1	2	0	6	6	6	1
17	17	18	15	ANZAC AVE	JAMES ST	FED	signals	Dec-97	TRAFFIC LIGHTS MODIFIED	Investigate	1227	4	3	3	1	5	4	3	6	
29	18	15	16	JAMES ST	WATER ST	FED	traffic signs	Aug-81	STOP SIGN SOUTH APPROACH ONLY	Monitor	1311	2	2	1	4	5	4	4	2	4
37	35	20	17	STEPHEN ST	WEST ST	TCC	signals	Nov-03	TRAFFIC LIGHTS MODIFIED (RIGHT TURNS WEST ST)	Monitor	1424	4	0	2	2	3	4	4	5	7
8	7	9	18	BRIDGE ST	RUTHVEN ST	DMR	signals	May-03	INTERSECTION & TRAFFIC LIGHTS UPGRADE	Monitor	641	4	4	8	2	4	5	4	3	5
26	14	13	19	BRIDGE ST	McDOUGALL ST	FED	signals	Nov-95	TRAFFIC LIGHTS INSTALLED	Monitor	252	1	3	4	6	0	5	5	1	3
31	22	31	20	BOUNDARY ST	BRIDGE ST	FED	traffic signs	Oct-01	STOP SIGN NORTH & SOUTH	Monitor	188	0	4	0	7	2	2	2	4	3
42	29	24	21	HERRIES ST	RUTHVEN ST	TCC	signals	2001	LOCAL AREA TRAFFIC MANAGEMENT	Monitor	1182	1	1	2	2	4	4	2	4	2
21	36	26	22	RUSSELL ST	ANZAC AVE & WEST ST	TCC	roundabout	May-04	LANE LINES AND SIGNAGE AMENDED	Monitor	897	5	2	3	2	3	1	5	5	3
16	21	21	23	STENNER ST	WEST ST	TCC	signals	Oct-87	TRAFFIC LIGHTS INSTALLED	Investigate	2048	4	4	5	2	3	1	4	5	3
25	28	29	24	ALDERLEY ST	ANZAC AVE	FED	signals	1993	TRAFFIC LIGHTS MODIFIED	Investigate	1676	2	1	3	2	6	2	0	5	4
48	43	36	25	ALDERLEY ST	DRAYTON RD	TCC	roundabout	Sep-89	ROUNDABOUT INSTALLED	Investigate	1717	0	1	4	2	2	1	3	7	1
7	10	11	26	HURSLEY RD	McDOUGALL ST	TCC	roundabout	2000	ROUNDABOUT INSTALLED	Monitor	941	1	6	6	6	5	0	3	0	0
33	26	25	27	JAMES ST	PECHEY & PRESCOTT STS	FED	signals	1997	TRAFFIC LIGHTS MODIFIED	Investigate	1306	2	4	3	2	1	4	4	3	5
35	19	28	28	BRIDGE ST	McGREGOR ST	FED	signals	Oct-96	TRAFFIC LIGHTS INSTALLED	Monitor	425	1	3	2	4	2	4	2	3	2
43	51	35	29	DRAYTON RD	WEST ST	TCC	traffic signs	Feb-91	CHANNELISATION MODIFIED	Monitor	1490	2	0	2	3	3	1	3	4	6
36	52	41	30	COHOE ST	JAMES ST	FED	traffic signs	Dec-92	CHANNELISATION MODIFIED	Monitor	1404	4	3	2	1	2	1	5	5	5
20	25	19	31	HUME ST	MARGARET ST	DMR	signals	2000	TRAFFIC LIGHTS MODIFIED	Investigate	1042	2	2	5	4	2	1	3	3	3
15	20	27	32	MARGARET ST	WEST ST	TCC	signals	Mar-65	TRAFFIC LIGHTS INSTALLED	Investigate	978	5	4	5	2	2	2	3	4	4
44	38	30	33	PERTH ST	RUTHVEN ST	DMR	traffic signs	Jan-84	GIVE-WAY SIGN EAST & WEST	Monitor	1430	1	2	3	2	2	2	4	3	1
56	40	43	34	MACKENZIE ST	MARGARET ST	TCC	no contol			Investigate	1099	0	1	1	3	3	3	1	3	4
19	37	34	35	BRIDGE ST	WEST ST	TCC	signals	1999	TRAFFIC LIGHTS MODIFIED	Monitor	590	7	2	4	1	2	2	3	4	2
81	80	49	36	RUTHVEN ST	SOUTH ST	DMR	traffic signs	Jul-82	GIVE-WAY SIGN EAST & WEST	Investigate	1595	3	0	1	1	1	3	4	3	
39	33	40	37	HERRIES ST	KITCHENER ST	TCC	signals	2001	TRAFFIC LIGHTS MODIFIED	Investigate	1224	0	3	3	4	1	1	2	4	
55	45	64	38	JELLICOE ST	RUTHVEN ST	DMR	signals	Apr-86	TRAFFIC LIGHTS INSTALLED	Planning	466	1	2	0	1	4	3	0	4	
28	15	23	39	JELLICOE ST	STUART ST	TCC	roundabout	2002	ROUNDABOUT INSTALLED	Monitor	502	1	3	3	3	4	4	1	0	
18	34	33	40	GEDDES ST	JAMES ST	FED	traffic signs	1996	TRAFFIC ISLANDS	Investigate	1351	6	2	4	2	2	1	3	3	
34	48	47	41	JAMES ST	KITCHENER ST	FED	signals	Jan-83	TRAFFIC LIGHTS INSTALLED	Investigate	1369	3	3	2	3	1	0	4	3	
63	49	56	42	ANZAC AVE	STEPHEN ST	FED	signals	Jun-94	TRAFFIC LIGHTS INSTALLED	Investigate	1372	1	2	0	2	2	3	2	2	
82	58	50	43	CAMPBELL ST	RUTHVEN ST	DMR	signals	Mar-65	TRAFFIC LIGHTS INSTALLED	Planning	801	1	0	0	2	3	3	2	1	
24	24	38	44	HERRIES ST	WEST ST	TCC	signals	Nov-00	TRAFFIC LIGHTS MODIFIED	Monitor	1097	1	7	2	3	1	1	4	1	
53	56	85	45	ALDERLEY ST	WEST ST	TCC	signals	Jul-86	TRAFFIC LIGHTS INSTALLED	Investigate	1748	1	3	1	1	2	1	1	5	
80	50	61	46	JAMES ST	CLIFFORD GARD	FED	signals	Jan-83	TRAFFIC LIGHTS INSTALLED	Monitor	6280	0	3	0	1	2	3	2	2	
45	32	39	47	BRIDGE ST	GREENWATTLE ST	FED	traffic signs	Aug-81	GIVE-WAY SIGN NORTH APPROACH ONLY	Monitor	346	2	2	1	3	2	4	1	0	
69	44	51	48	KITCHENER ST	MARGARET ST	TCC	roundabout	Aug-03	ROUNDABOUT & TRAFFIC LIGHTS INSTALLED	Monitor	1045	0	0	1	4	2	3	0	1	
125	99	42	49	COHOE ST	HERRIES ST	FED	traffic signs	Aug-69	STOP SIGN EAST APPROACH ONLY	Investigate	1285	2	0	1	0	1	3	6	0	
41	41	37	50	HERRIES ST	PHILLIP ST	TCC	traffic signs	May-04	DOUBLE BARRIER LINES	Monitor	1213	2	2	3	2	2	2	3	1	
47	55	54	51	MORT ST	TAYLOR ST	TCC	traffic signs	Jun-74	STOP SIGN EAST & WEST	Investigate	843	1	3	2	2	2	0	4	2	
166	115	82	52	RAMSAY ST	STENNER ST	TCC	roundabout	Jul-91	ROUNDABOUT INSTALLED	Investigate	2151	0	0	1	2	0	2	2	4	
193	119	83	53	ANZAC AVE	HILL ST	TCC	signals	Sep-87	THIRD PHASE INSTALLED FOR PEDS	Investigate	1005	0	0	0	0	3	2	2	3	
64	57	48	54	RUSSELL ST	RUTHVEN ST	TCC	signals	Nov-96	TRAFFIC LIGHTS MODIFIED	Monitor	954	2	2	2	0	1	3	4	1	
66	121	86	55	ANZAC AVE	SOUTH ST	FED	signals	Jun-98	TRAFFIC LIGHTS MODIFIED	Investigate	1470	3	0	0	4	0	0	2	3	
57	69	66	56	MACKENZIE ST	SOUTH ST	TCC	roundabout	Apr-87	ROUNDABOUT INSTALLED	Monitor	1678	3	1	0	1	3	2	2	1	
40	70	67	57	GLENVALE RD	GREENWATTLE ST	TCC	roundabout	Feb-99	ROUNDABOUT INSTALLED	Monitor	1161	4	2	1	3	1	0	3	2	
32	23	32	58	DRAYTON RD	SOUTH ST	TCC	signals	Jul-98	TRAFFIC LIGHTS INSTALLED	Monitor	1536	2	4	4	0	3	4	2	0	
282	177	80	59	HURSTAWAY CT	RUTHVEN ST	DMR	traffic signs			Investigate	2193	0	0	1	0	0	2	4	3	
51	78	45	60	MARGARET ST	NEIL ST	TCC	signals	Jun-96	TRAFFIC LIGHTS MODIFIED	Investigate	1032	2	0	2	3	2	0	4	0	
96	81	88	61	HUME ST	STENNER ST	TCC	roundabout	Nov-89	ROUNDABOUT INSTALLED	Investigate	2114	0	0	1	3	1	1	0	3	
46	68	57	62	HOLBERTON ST	TAYLOR ST	TCC	signals	Dec-86	TRAFFIC LIGHTS INSTALLED	Planning	759	5	0	1	3	1	2	2	0	
85	60	91	63	HUME ST	LONG ST	TCC	roundabout	Apr-88	ROUNDABOUT INSTALLED	Monitor	1514	0	3	0	3	0	2	1	2	
70	46	52	64	BRIDGE ST	GAYDON ST & GORDON AVE	TCC	traffic signs	Sep-82	STOP SIGN SOUTH APPROACH ONLY	Investigate	565	0	2	2	3	0	3	2	0	
101	62	65	65	TAYLOR ST	WYALLA ST	DMR	no contol			Investigate	699	0	1	1	2	1	3	1	1	
124	98	75	66	MARGARET ST	MARY ST	TCC	signals	Aug-80	TRAFFIC LIGHTS INSTALLED	Monitor	1073	1	0	0	1	2	2	2	1	
49	47	58	67	LINDSAY ST	MARGARET ST	TCC	roundabout	Nov-03	ROUNDABOUT INSTALLED	Monitor	1068	1	3	2	3	0	2	2	1	
27	64	96	68	GREENWATTLE ST	SOUTH ST	TCC	traffic signs	May-90	STOP SIGN EAST APPROACH ONLY	Monitor	1444	6	3	3	2	0	0	1	5	
75	74	69	69	CURZON ST	HERRIES ST	TCC	traffic signs	Jan-84	GIVE-WAY SIGN NORTH & SOUTH	Investigate	1276	1	1	2	1	2	1	2	2	
89	75	97	70	ROWBOTHAM ST	SOUTH ST	TCC	traffic signs	Sep-75	STOP SIGN WEST APPROACH ONLY	Monitor	1722	0	1	0	3	2	1	0	2	
77	65	55	71	HOGG ST	TOR ST	TCC	traffic signs	2002	ADDITIONAL GIVE-WAY SIGN & SPLITTER ISLAND	Monitor	65	1	0	5	0	1	2	2	3	
109	93	60	72	GRIFFITHS ST	HOGG & MORT STS	TCC	traffic signs	Dec-87	GIVE-WAY SIGN EAST & WEST	Monitor	80	0	1	3	0	1	1	4	2	
313	249	162	73	RUTHVEN ST	AT HARVEY NORMAN	DMR	traffic signs			Investigate		0	0	0	0	0	2	1	5	
9	27	46	74	HERRIES ST	HUME ST	DMR	signals	1998	TRAFFIC LIGHTS & CHANNELISATION MODIFIED	Monitor	1198	8	7	4	1	2	0	3	1	
52	79	84	75	HERRIES ST	NEIL ST	TCC	signals	Apr-89	TRAFFIC LIGHTS MODIFIED	Monitor	1191	3	1	0	2	2	1	1	1	
65	66	72	76	MARGARET ST	VICTORIA ST	TCC	signals	Nov-97	TRAFFIC LIGHTS MODIFIED	Monitor	1012	1	0	1	3	2	1	0	1	

RANKING				*Data was initially limited to intersections with 4 or more accidents since 1987 (from the Accident Database)*								ANNUAL CRASH DATA								
												332	308	343	325	321	332	357	392	138
96-00 CRASH RANK	97-01 CRASH RANK	98-02 CRASH RANK	99-03 CRASH RANK	MAJOR STREET	MINOR STREET	OWNER	control	LAST TREATMENT DATE	INTERSECTION TREATMENT	INV STATUS	UNIQUE IDENTIFIER (GIS - See Matthew Andretta)	1996	1997	1998	1999	2000	2001	2002	2003	2004
152	95	102	77	HERRIES ST	PRESCOTT ST	TCC	traffic signs			Monitor	1125	0	2	0	1	0	2	2	2	
68	59	63	78	BRIDGE ST	MORT ST	TCC	signals	Apr-87	TRAFFIC LIGHTS INSTALLED	Monitor	622	0	1	4	1	1	1	1	3	
83	83	90	79	JAMES ST	MACKENZIE ST	FED	signals	Jul-95	TRAFFIC LIGHTS INSTALLED	Investigate	1389	2	2	0	1	1	2	2	1	
30	39	92	80	ALDERLEY ST	HUME ST	TCC	roundabout	Jul-86	ROUNDABOUT INSTALLED	Monitor	1817	2	6	2	0	3	0	1	3	
98	124	104	81	GREENWATTLE ST	TAYLOR ST	DMR	signals	1995	TRAFFIC LIGHTS INSTALLED	Monitor	679	2	0	2	1	0	1	1	4	
247	96	74	82	NORTH ST	TOR ST	TCC	roundabout	Mar-88	ROUNDABOUT INSTALLED	Monitor	264	0	0	0	1	0	4	2	0	
71	53	53	83	RUTHVEN ST	SPRING ST	DMR	signals	Mar-99	TRAFFIC LIGHTS INSTALLED	Monitor	2278	0	2	3	1	1	2	3	0	
58	100	108	84	CLIFFORD ST	MARGARET ST	TCC	signals	Aug-96	TRAFFIC LIGHTS INSTALLED	Monitor	990	3	1	0	1	3	0	1	2	
50	102	109	85	CURZON ST	MARGARET ST	TCC	traffic signs			Monitor	1109	4	0	1	1	3	0	0	3	
73	54	44	86	CAMPBELL ST	HUME ST	TCC	signals	Nov-86	TRAFFIC LIGHTS INSTALLED	Planning	823	0	1	4	1	1	2	3	0	
154	87	68	87	ANZAC AVE	CANNING ST	FED	traffic signs		STOP SIGN EAST APPROACH ONLY	Monitor	2109	0	0	2	1	0	3	2	1	
61	72	94	88	HUME ST	SPRING ST	TCC	roundabout	2001	ROUNDABOUT INSTALLED	Monitor	2291	1	2	2	1	2	0	1	3	
74	73	76	89	NELSON ST	RUTHVEN ST	DMR	traffic signs	Mar-99	LOCAL AREA TRAFFIC MANAGEMENT	Monitor	2394	0	2	2	2	1	0	2	2	
104	88	95	90	CAMPBELL ST	MARY ST	TCC	traffic signs	Jun-91	STOP SIGN EAST & WEST	Monitor	871	0	0	1	3	1	1	0	2	
88	63	77	91	GLENVALE RD	McDOUGALL ST	TCC	traffic signs	Jul-88	STOP SIGN NORTH & SOUTH	Planning	1107	1	2	0	1	2	3	1	0	
129	77	78	92	FITZPATRICK ST	TARA ST	TCC	traffic signs	Apr-85	GIVE-WAY SIGN EAST & WEST	Investigate	317	0	0	1	1	2	3	0	1	
192	116	111	93	BALL ST	GIPPS ST	TCC	traffic signs	Feb-79	STOP SIGN WEST APPROACH ONLY	Investigate	2116	0	0	0	2	1	2	0	2	
195	149	89	94	BRIDGE ST	RICHMOND DR	FED	signals	Oct-96	TRAFFIC LIGHTS INSTALLED	Investigate	402	1	0	0	1	0	2	3	0	
122	82	103	95	SOUTH ST	WEST ST	TCC	signals	Apr-98	TRAFFIC LIGHTS MODIFIED	Investigate	1541	0	3	0	0	1	2	2	1	
54	61	73	96	BRIDGE ST	HUME ST	TCC	signals	Sep-86	TRAFFIC LIGHTS INSTALLED	Monitor	668	1	1	3	2	1	1	0	2	
86	85	106	97	CHALK DR	NEIL ST	DMR	signals	Jul-88	TRAFFIC LIGHTS INSTALLED	Monitor	915	2	2	0	1	1	2	1	1	
59	71	124	98	GREENWATTLE ST	HURSLEY RD	TCC	roundabout	Nov-92	ROUNDABOUT INSTALLED	Monitor	982	2	3	0	1	2	1	0	2	
76	76	59	99	ERIN ST	FITZPATRICK ST	TCC	traffic signs	Jul-02	GIVE-WAY SIGN NORTH & SOUTH	Investigate	312	1	0	3	2	1	1	2	0	
114	92	79	100	O'QUINN ST	WEST ST	TCC	no contol			Monitor	1333	1	1	1	2	0	2	2	0	

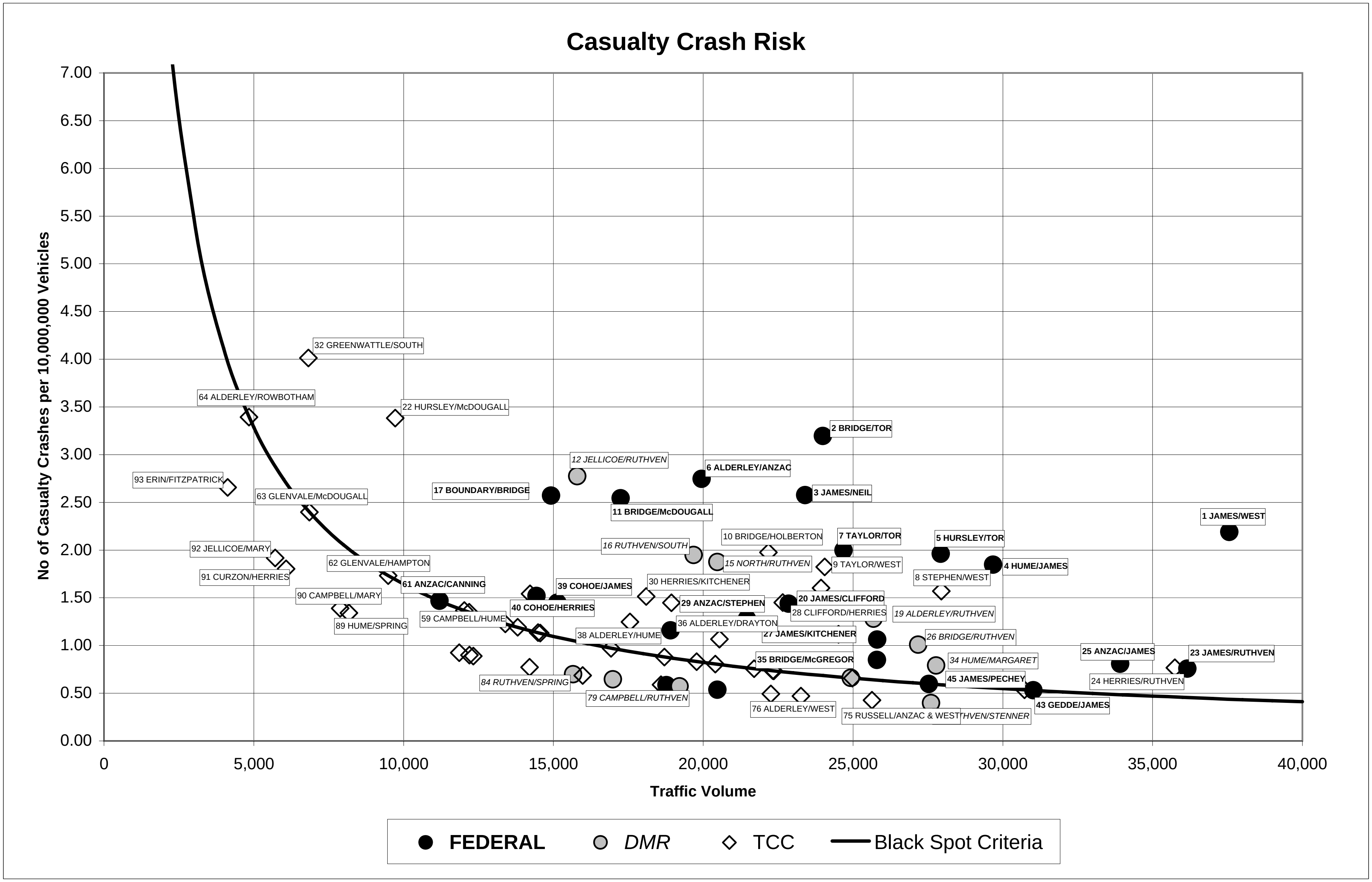
*Main Roads advised on 28/03/02 that an AADT Calibration factor of 1.23 should be used for Toowoomba

INJURY DATA (Total No of			CRASHES ONLY			5 YR CASUALTY CRASH TOTALS					Casulty Ranking					COUNT DATA									ACCIDENT, INJURY AND CASUALTY ANALYSIS (99-03)					
119	157	42	94	118	32	529	556	544	543	469																				
2002	2003	2004	2002	2003	2004	CAS 96-00	CAS 97-01	CAS 98-02	CAS 99-03	CAS 00-04	96-00 CASUALTY RANK	97-01 CASUALTY RANK	98-02 CASUALTY RANK	99-03 CASUALTY RANK	00-04 CASUALTY RANK	COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F	ANNUAL VOL	LOCATION	CRASH/ 1000 VEH-AADT	CRASH/ 1,000,000 VEH	INJURY/ 1000 VEH-AADT	INJURY/ 1,000,000 VEH	CASUALTY /1000 VEH-AADT	CASUALTY/ 1,000,000 VEH
4	5	4	2	3	4	8	12	12	14	15	9	2	2	2		8/22/2001	Wednesday	6am-6pm*	19,513	1.23	24,001	349	8,376,184	BRIDG/TOR S	1.62	0.93	0.79	0.45	0.58	0.33
1	4	2	1	3	1	7	13	13	15	13	12	1	1	1		8/21/2001	Tuesday	6am-6pm*	30,538	1.23	37,562	354	13,287,146	JAMES/WEST	0.93	0.53	0.61	0.35	0.40	0.23
1	7	1	1	4	1	7	7	8	10	8	14	12	8	4		2/14/2002	Thursday	6am-6pm*	24,131	1.23	29,681	327	9,707,036	HUME /JAMES	1.11	0.68	0.47	0.29	0.34	0.21
1	5	2	1	4	1	6	9	9	10	9	17	7	5	5		3/28/2002	Thursday	6am-6pm*	22,711	1.23	27,935	327	9,135,821	HURSL/TOR S	1.04	0.63	0.43	0.26	0.36	0.22
2	0	3	1	0	1	6	7	8	6	6	19	14	9	19		9/11/2002	Wednesday	6am-6.15pm*	20,883	1.23	25,686	349	8,964,273	ALDER/RUTHV	1.09	0.62	0.35	0.20	0.23	0.13
0	3	1	0	1	1	9	7	5	2	3	4	13	26	74		8/28/2002	Wednesday	6am-6pm*	22,449	1.23	27,612	349	9,636,497	RUTHV/STENN	0.91	0.52	0.14	0.08	0.07	0.04
1	2	1	1	2	1	11	10	8	9	7	1	5	12	7		4/18/2002	Thursday	6am-6pm*	20,071	1.23	24,687	327	8,073,844	TAYLO/TOR S	0.93	0.57	0.41	0.25	0.36	0.22
2	0	0	2	0	0	9	9	10	8	5	6	8	3	10		9/10/1998	Thursday	7am-6pm	17,501	1.27	22,181	327	7,254,243	BRIDG/HOLBE	1.04	0.63	0.36	0.22	0.36	0.22
1	6	0	1	4	0	2	1	2	5	5	73	113	73	23		3/13/2003	Thursday	6am-6pm*	29,404	1.23	36,167	327	11,828,175	JAMES/RUTHV	0.61	0.37	0.19	0.12	0.14	0.08
0	1	0	0	1	0	6	6	4	5	3	21	19	39	28		5/20/2004	Thursday	6am-6pm	20,003	1.23	24,513	327	8,016,987	CLIFF/HERRI	0.90	0.55	0.20	0.12	0.20	0.12
7	0	0	5	0	0	6	4	9	8	7	22	35	6	9		8/29/2002	Thursday	6am-6pm	19,555	1.23	24,053	327	7,866,275	TAYLO/WEST	0.91	0.56	0.54	0.33	0.33	0.20
0	4	1	0	3	1	3	3	2	3	4	52	52	76	46		4/2/2003	Wednesday	6am-6pm*	20,270	1.23	24,932	349	8,701,136	LONG /RUTHV	0.84	0.48	0.16	0.09	0.12	0.07
1	3	0	1	3	0	10	8	8	11	7	2	10	11	3		2/20/2002	Wednesday	6am-6pm*	19,031	1.23	23,408	349	8,169,280	JAMES/NEIL	0.94	0.54	0.81	0.47	0.47	0.27
5	1	0	3	1	0	3	5	6	7	6	55	28	22	15		3/15/2001	Thursday	6am-6pm*	16,647	1.23	20,476	327	6,696,491	NORTH/RUTHV	0.98	0.60	0.44	0.27	0.34	0.21
1	2		1	2		5	5	5	5	4	27	25	25	25		8/23/2001	Thursday	6am-6pm*	27,579	1.23	33,922	327	11,094,043	ANZAC/JAMES	0.56	0.34	0.27	0.16	0.15	0.09
1	0	0	1	0	0	3	5	6	5	4	70	33	23	33																
4	2	5	2	2	3	3	5	7	9	11	50	27	16	8		6/13/2002	Thursday	6am-6pm	22,723	1.23	27,949	327	9,140,648	STEPH/WEST	0.64	0.39	0.54	0.33	0.32	0.20
0	0	0	0	0	0	9	11	8	5	4	5	4	10	26		7/18/2002	Thursday	6am-6pm*	22,099	1.23	27,182	327	8,889,635	BRIDG/RUTHV	0.66	0.40	0.33	0.20	0.18	0.11
2	0	0	2	0	0	5	8	8	8	5	29	11	14	11		7/31/2002	Wednesday	6am-6pm*	14,024	1.23	17,250	349	6,019,967	BRIDG/McDOU	0.99	0.56	0.41	0.23	0.46	0.27
0	0	1	0	0	1	6	7	7	7	3	26	17	20	17		3/14/2002	Thursday	6am-6pm*	12,131	1.23	14,921	327	4,879,866	BOUND/BRIDG	1.14	0.70	0.60	0.37	0.47	0.29
0	1	1	0	1	1	4	5	5	5	6	36	24	24	24		2/19/2004	Thursday	6am-6pm	29,163	1.23	35,739	327	11,688,217	HERRI/RUTHV	0.45	0.27	0.11	0.07	0.14	0.09
1	3	1	1	2	1	1	0	1	3	4	108	212	118	75		3/15/2001	Thursday	7am-6pm	20,226	1.27	25,635	327	8,383,767	RUSSE/ANZAC	0.62	0.38	0.16	0.10	0.12	0.07
1	1	2	1	1	2	6	4	5	3	5	23	39	30	50		6/14/2001	Thursday	7am-5.30pm	16,144	1.34	21,699	327	7,096,504	STENN/WEST	0.69	0.42	0.14	0.08	0.14	0.08
0	2	1	0	2	1	8	9	8	10	9	10	9	13	6		8/20/2003	Wednesday	6am-6pm*	16,222	1.23	19,953	349	6,963,484	ALDER/ANZAC	0.75	0.43	0.60	0.34	0.50	0.29
1	1	0	1	1	0	2	2	3	4	4	76	80	51	36		6/20/2002	Thursday	7-9am & 3-5pm	6,532	3.14	20,541	327	6,717,772	ALDER/DRAYT	0.73	0.45	0.19	0.12	0.19	0.12
1	0	0	1	0	0	10	10	9	6	3	3	6	7	22		11/5/1998	Thursday	7am-6pm	7,669	1.27	9,720	327	3,178,835	HURSL/McDOU	1.44	0.88	0.93	0.57	0.62	0.38
0	1	2	0	1	1	6	6	2	3	3	18	18	74	45		8/1/2002	Thursday	6am-6pm*	22,386	1.23	27,535	327	9,005,085	JAMES/PECHE	0.51	0.31	0.15	0.09	0.11	0.07
0	1	2	0	1	1	4	4	3	4	2	37	34	49	35		6/18/1998	Thursday	6am-6pm	21,505	1.20	25,806	327	8,439,698	BRIDG/McGRE	0.58	0.36	0.16	0.09	0.16	0.09
0	4	4	0	3	3	4	4	4	6	8	39	38	40	21		11/19/1998	Thursday	8-9am & 2-4pm	5,437	4.17	22,654	327	7,408,910	DRAYT/WEST	0.62	0.38	0.44	0.27	0.26	0.16
2	0	1	2	0	1	5	4	5	4	5	31	42	32	39		7/30/2003	Wednesday	6am-6pm*	12,308	1.23	15,139	349	5,283,354	COHOE/JAMES	0.92	0.53	0.26	0.15	0.26	0.15
3	0	1	3	0	1	3	3	6	4	5	49	51	21	34		9/4/2002	Wednesday	6am-6pm*	22,582	1.23	27,776	349	9,693,589	HUME /MARGA	0.47	0.27	0.14	0.08	0.14	0.08
2	2	2	2	2	1	7	6	7	7	8	16	20	17	14		10/22/1998	Thursday	7am-6pm	18,881	1.27	23,930	327	7,826,259	MARGA/WEST	0.54	0.33	0.29	0.18	0.29	0.18
1	0	0	1	0	0	3	2	3	1	1	57	82	54	123		4/2/1998	Thursday	6am-6pm	16,213	1.20	19,456	327	6,362,838	PERTH/RUTHV	0.67	0.41	0.05	0.03	0.05	0.03
0	0	3	0	0	3	2	2	2	2	4	82	88	84	85		6/6/2002	Thursday	6am-11:45am & 12:30-6pm	10,843	1.31	14,204	327	4,645,441	MACKE/MARGA	0.92	0.56	0.14	0.09	0.14	0.09
1	2	1	1	1	1	7	3	4	3	3	15	53	38	47		2/14/1997	Friday	8-10.30&1.30-6	13,490	1.85	24,981	321	8,018,747	BRIDG/WEST	0.48	0.30	0.16	0.10	0.12	0.07
5	0		4	0		3	3	7	7	7	56	57	18	16		4/5/2001	Thursday	6am-6pm*	16,006	1.23	19,687	327	6,438,640	RUTHV/SOUTH	0.61	0.37	0.41	0.25	0.36	0.22
2	1		1	1		6	7	7	5	4	25	16	19	30		11/6/1998	Friday	7am-6pm	14,944	1.27	18,940	321	6,079,644	HERRI/KITCH	0.63	0.39	0.42	0.26	0.26	0.16
0	6		0	4		4	5	4	8	8	41	30	43	12		3/12/2003	Wednesday	6am-6pm*	12,846	1.23	15,801	349	5,514,296	JELLI/RUTHV	0.76	0.44	0.63	0.36	0.51	0.29
3	0		1	0		9	12	10	8	6	7	3	4	13		10/20/1998	Thursday	8-9am & 2-4pm	820	4.17	3,417	327	1,117,400	JELLI/STUAR	3.51	2.15	4.68	2.86	2.34	1.43
0	0		0	0		7	5	4	3	3	13	26	37	43		5/14/1998	Thursday	7am-6.30pm*	25,224	1.23	31,025	327	10,146,541	GEDDE/JAMES	0.35	0.22	0.23	0.14	0.10	0.06
0	1		0	1		8	7	5	5	2	8	15	27	27		9/12/2002	Thursday	6am-6pm*	20,982	1.23	25,808	327	8,440,306	JAMES/KITCH	0.43	0.26	0.19	0.12	0.19	0.12
1	0		1	0		4	6	5	5	3	38	21	28	29		8/13/2003	Wednesday	6am-6pm*	17,450	1.23	21,464	349	7,490,617	ANZAC/STEPH	0.51	0.29	0.23	0.13	0.23	0.13
0	0		0	0		0	2	2	2	2	209	83	79	79		10/26/2000	Thursday	6am-6pm*	15,625	1.23	19,219	327	6,285,377	CAMPB/RUTHV	0.57	0.35	0.10	0.06	0.10	0.06
2	0		2	0		3	3	3	3	2	48	50	48	44		4/30/1998	Thursday	7am-6pm	24,240	1.27	30,722	327	10,047,588	HERRI/WEST	0.33	0.20	0.10	0.06	0.10	0.06
0	1		0	1		5	4	2	2	2	28	36	77	76		8/8/2002	Thursday	6am-6pm	18,982	1.23	23,262	327	7,607,781	ALDER/WEST	0.43	0.26	0.09	0.05	0.09	0.05
3	1		2	1		2	4	5	6	6	74	37	29	20		8/15/2002	Thursday	6am-6pm*	18,583	1.23	22,857	327	7,475,275	JAMES/CLIFF	0.44	0.27	0.31	0.19	0.26	0.16
0	0		0	0		4	5	4	4	3	40	29	42	37		4/22/1999	Thursday	8-9am & 2-4pm	4,539	4.17	18,913	327	6,185,220	BRIDG/GREEN	0.53	0.32	0.37	0.23	0.21	0.13
0	0		0	0		1	1	1	1	0	116	121	123	125		5/2/2002	Thursday	6am-6pm	13,849	1.23	16,972	327	5,550,530	KITCH/MARGA	0.59	0.36	0.12	0.07	0.06	0.04
2	0		2	0		2	3	5	4	4	81	64	33	40		3/6/2003	Thursday	6am-6pm*	11,740	1.23	14,440	327	4,722,581	COHOE/HERRI	0.69	0.42	0.35	0.21	0.28	0.17
2	0		1	0		3	4	5	3	3	64	44	34	58		11/20/1998	Friday	8-9am & 2-4pm	3,214	4.17	13,392	321	4,298,560	HERRI/PHILL	0.75	0.47	0.37	0.23	0.22	0.14
0	0		0	0		5	4	2	1	0	34	46	86	133		10/16/1998	Friday	8-9am & 2-4pm	2,500	4.17	10,417	321	3,343,621	MORT /TAYLO	0.96	0.60	0.10	0.06	0.10	0.06
0	1		0	1		1	1	1	1	1	156	154	154	157		8/5/2004	Thursday	6am-6pm	12,315	1.23	15,092	327	4,935,720	RAMSA/STENN	0.66	0.41	0.07	0.04	0.07	0.04
0	2		0	1		0	0	0	1	1	244	233	219	144																
3	0		2	0		3	2	4	3	3	53	79	41	48		5/6/1999	Thursday	7am-6pm	17,639	1.27	22,356	327	7,311,444	RUSSE/RUTHV	0.40	0.25	0.18	0.11	0.13	0.08
0	2		0	2		0	0	0	2	2	206	214	201	78		7/24/2002	Wednesday	6am-6pm	16,649	1.23	20,478	349	7,146,979	ANZAC/SOUTH	0.44	0.25	0.10	0.06	0.10	0.06
1	1		1	1		2	3	3	4	4	83	65	61	41		3/26/1999	Friday	8-9am & 2-4pm	3,414	4.17	14,225	321	4,566,049	MACKE/SOUTH	0.63	0.39	0.28	0.18	0.28	0.18
1	2		1	1		2	2	3	3	3	84	89	62	57		6/14/2002	Friday	7-9am & 3-5pm	4,390	3.14	13,805	321	4,431,245	GLENV/GREEN	0.65	0.41	0.29	0.18	0.22	0.14
2	0		1	0		5	6	5	3	3	33	23	36	60		8/12/2004	Thursday	6am-6pm	10,876	1.23	13,328	327	4,358,984	DRAYT/SOUTH	0.68	0.41	0.45	0.28	0.23	0.14
1	0		1	0		1	2	3	2	2	200	110	72	105																
1	0		1	0		2	1	2	2	1	94	137	95	98		8/26/2004	Thursday	6am-6pm	14932	1.23	18,299	327	5,984,585	MARGA/NEIL	0.49	0.30	0.16	0.10	0.11	0.07
0	0		0	0		0	0	0	0	0	210	216	203	204		3/15/2002	Friday	7am-6pm	15,140	1.27	19,189	321	6,159,383	HUME /STENN	0.42	0.26	0.00	0.00	0.00	0.00
0	0		0	0		3	3	3	2	2	58	58	55	81		11/6/2003	Thursday	6am-6pm	15,170	1.23	18,591	327	6,079,973	HOLBE/TAYLO	0.43	0.26	0.11	0.07	0.11	0.07
0	2		0	2		3	4	3	5	3	59	40	56	31		6/21/2002	Friday	7-9am & 3-5pm	5,754	3.14	18,094	321	5,808,060	HUME /LONG	0.44	0.28	0.28	0.17	0.28	0.17
0	0		0	0		3	3	2	1	0	61	60	83	127		8/9/2002	Friday	7-9am & 3-5pm	5,175	3.14	16,274	321	5,223,620	BRIDG/GAYDO	0.49	0.31	0.06	0.04	0.06	0.04
0	1		0	1		1	1	1	1	1	119	122	126	128		6/6/2002	Thursday	7-9am & 3-5pm	4,871	3.14	15,318	327	5,009,533	TAYLO/WYALL	0.52	0.32	0.07	0.04	0.07	0.04
1	0		1	0		2	2	3	3	3	80	87	59	55		11/13/2003	Thursday	6am-6pm	11879	1.23	14,558	327	4,760,975	MARGA/MARY	0.55	0.34	0.21	0.13	0.21	0.13
1	0		1	0		1	1	2	2	1	121	124	85	86		11/24/1998	Tuesday	8-9am & 2-4pm	2,928	4.17	12,200	354	4,315,646	LINDS/MARGA	0.66	0.37	0.16	0.09	0.16	0.09
0	4		0	3		8	3	2	5	3	11	69	90	32		10/29/1998	Thursday	8am-6pm	4,996	1.37	6,825	327	2,232,120	GREEN/SOUTH	1.17	0.72	1.47	0.90	0.73	0.45
0	0		0	0		2	3	3	2	2	88	70	66	91		6/13/2002	Thursday	7-9am & 3-5pm	1,932	3.14	6,075	327	1,986,947	CURZO/HERRI	1.32	0.81	0.66	0.40	0.33	0.20
0	0		0	0		1	1	1	1	0	128	129	134	137		6/21/2002	Friday	7-9am & 3-5pm	1,362	3.14	4,283	321	1,374,796	ROWBO/SOUTH	1.87	1.16	0.47	0.29	0.23	0.15
2	3		4	1		4	4	8	7	7	45	47	15	18		6/7/2002	Friday	7-9am & 3-5pm	1,294	3.14	4,069	321	1,306,157	HOGG /TOR S	1.97	1.22	2.21	1.38	1.72	1.07
1	1		1	1		1	1	2	2	2	138	149	101	106																
0	3		0	2		0	1	1	3	3	313	136	141	65																
0	0		0	0		6	2	1	1	1	20	78	117	119		9/5/2002	Thursday	6am-6pm*	21,939	1.23	26,985	327	8,825,273	HERRI/HUME	0.26	0.16	0.04	0.02	0.04	0.02
0	0		0	0		0	0	0	0	0	205	213	200	201		11/13/1998	Friday	8-9am & 2-4pm	6,017	4.17	25,071	321	8,047,428	HERRI/NEIL	0.28	0.17	0.00	0.00	0.00	0.00
0	0		0	0		3	3	3	3	1	54	55	50	49		8/27/2004	Friday	6am-6pm	15,771	1.23	19,327	321	6,203,794	MARGA/VICTO	0.36	0.23	0.21	0.13	0.16	0.10

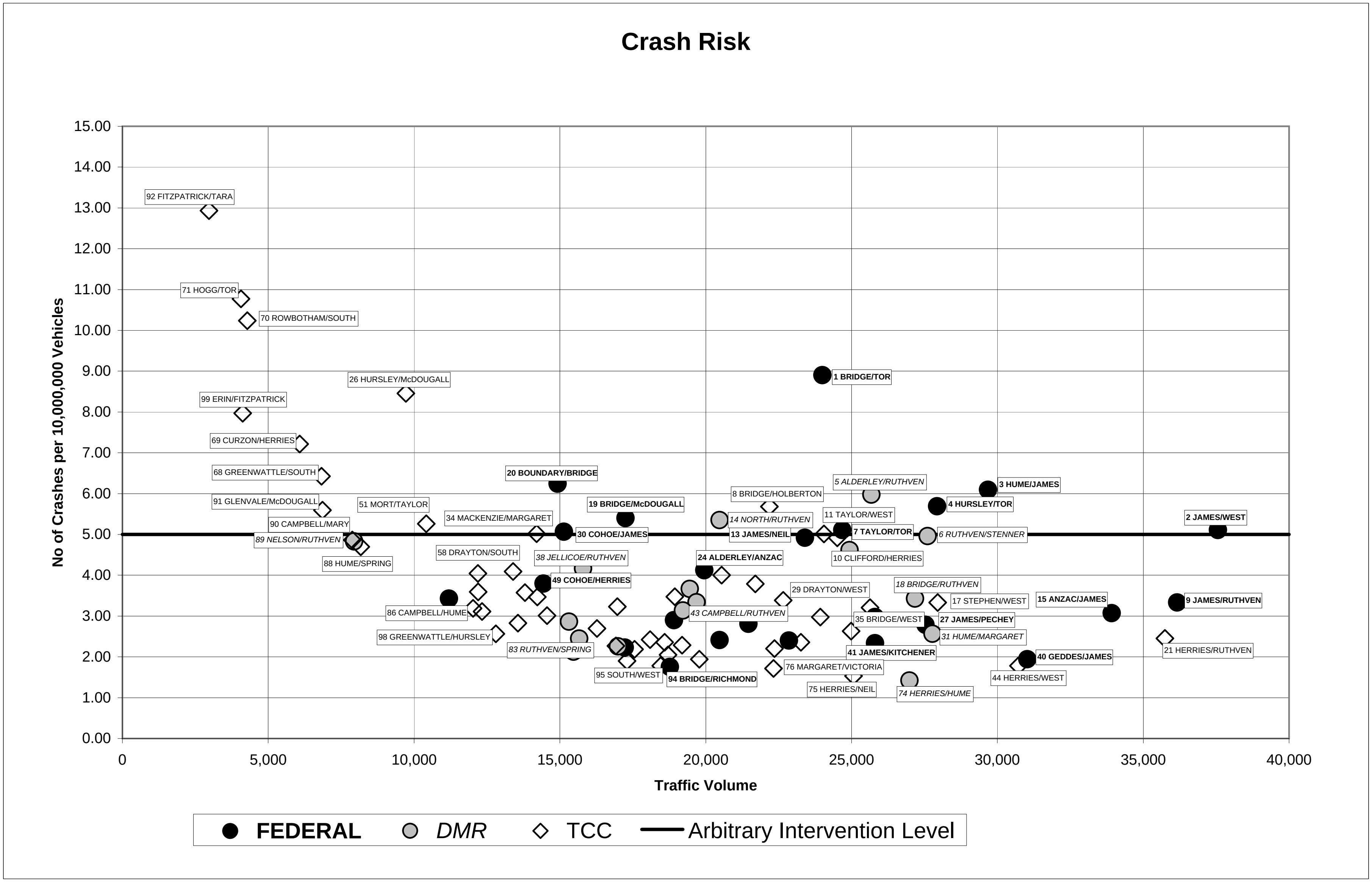
INJURY DATA (Total No of			CRASHES ONLY			5 YR CASUALTY CRASH TOTALS					Casulty Ranking					COUNT DATA									ACCIDENT, INJURY AND CASUALTY ANALYSIS (99-03)					
119	157	42	94	118	32	529	556	544	543	469																					
2002	2003	2004	2002	2003	2004	CAS 96-00	CAS 97-01	CAS 98-02	CAS 99-03	CAS 00-04	96-00 CASUALTY RANK	97-01 CASUALTY RANK	98-02 CASUALTY RANK	99-03 CASUALTY RANK	00-04 CASUALTY RANK	COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F	ANNUAL VOL	LOCATION	CRASH/ 1000 VEH-AADT	CRASH/ 1,000,000 VEH	INJURY/ 1000 VEH-AADT	INJURY/ 1,000,000 VEH	CASUALTY /1000 VEH-AADT	CASUALTY/ 1,000,000 VEH
3	0		1	0		0	2	3	3	3	208	81	53	52		4/24/2004	Thursday	6am-6pm	16,141	1.23	19,781	327	6,469,139	HERRI/PRESC	0.35	0.22	0.25	0.15	0.15	0.09
0	3		0	1		6	6	5	3	2	24	22	31	53		10/24/2002	Thursday	7-9am & 3-5pm	5,948	3.14	18,704	327	6,117,163	BRIDG/MORT	0.37	0.23	0.32	0.20	0.16	0.10
0	0		0	0		1	0	0	0	0	114	217	205	206		8/6/2003	Wednesday	6am-6pm*	14,005	1.23	17,226	349	6,011,811	JAMES/MACKE	0.41	0.23	0.00	0.00	0.00	0.00
1	2		1	2		3	3	2	4	4	60	59	81	38		11/5/1998	Thursday	8-9am & 2-4pm	4,214	4.17	17,558	327	5,742,348	ALDER/HUME	0.40	0.24	0.23	0.14	0.23	0.14
0	1		0	1		1	2	2	2	2	117	85	82	82		8/12/1994	Fri (pre-signa	7.30am-5.30pm	12,157	1.40	16,991	321	5,453,874	GREEN/TAYLO	0.41	0.26	0.12	0.07	0.12	0.07
2	0		1	0		1	2	3	3	2	118	86	58	54		4/23/1999	Friday	8-9am & 2-4pm	4,061	4.17	16,921	321	5,431,379	NORTH/TOR S	0.41	0.26	0.24	0.15	0.18	0.11
1	0		1	0		2	3	4	2	2	79	61	45	84		9/4/2003	Thursday	6am-6pm*	12,736	1.23	15,665	327	5,123,236	RUTHV/SPRIN	0.45	0.27	0.13	0.08	0.13	0.08
0	1		0	1		1	1	0	1	1	120	123	211	129		8/19/1994	Friday	7.30am-5.30pm	9,704	1.40	13,563	321	4,353,409	CLIFF/MARGA	0.52	0.32	0.07	0.05	0.07	0.05
0	2		0	1		2	1	1	2	2	86	125	128	87		10/18/2002	Friday	6am-6pm	10,060	1.23	12,328	321	3,957,274	CURZO/MARGA	0.57	0.35	0.24	0.15	0.16	0.10
0	0		0	0		3	5	5	3	3	65	31	35	59		11/26/1998	Thursday	8-9am & 2-4pm	2,886	4.17	12,025	327	3,932,704	CAMPB/HUME	0.58	0.36	0.42	0.25	0.25	0.15
2	0		2	0		1	2	4	3	3	124	91	46	61		2/28/2002	Thursday	6am-6pm*	9,106	1.23	11,200	327	3,663,017	ANZAC/CANNI	0.62	0.38	0.27	0.16	0.27	0.16
0	0		0	0		3	3	2	2	1	67	67	87	89		10/30/1998	Friday	8-9am & 2-4pm	1,961	4.17	8,171	321	2,622,737	HUME /SPRIN	0.86	0.53	0.37	0.23	0.24	0.15
1	0		1	0		2	2	2	1	1	87	93	88	135		5/18/2000	Thursday	6am-6pm*	6,462	1.23	7,948	327	2,599,431	NELSO/RUTHV	0.88	0.54	0.13	0.08	0.13	0.08
0	0		0	0		1	2	2	2	1	126	94	89	90		8/8/2002	Thursday	7-9am & 3-5pm	2,507	3.14	7,884	327	2,578,300	CAMPB/MARY	0.89	0.54	0.25	0.16	0.25	0.16
0	0		0	0		4	3	3	3	2	43	68	65	63		7/25/2002	Thursday	6am-6pm	5,594	1.23	6,855	327	2,242,015	GLENV/McDOU	1.02	0.62	0.58	0.36	0.44	0.27
0	0		0	0		0	1	1	1	1	221	132	137	140		7/18/2002	Thursday	7-9am & 3-5pm	943	3.14	2,965	327	969,819	FITZP/TARA	2.36	1.44	0.34	0.21	0.34	0.21
0	2		0	1		1	2	2	3	3	169	103	102	68																
0	0		0	0		0	2	2	2	2	211	84	80	80		8/29/2002	Thursday	6am-6pm*	15,265	1.23	18,776	327	6,140,562	BRIDG/RICHM	0.32	0.20	0.11	0.07	0.11	0.07
0	0		0	0		1	1	0	0	0	113	119	204	205		8/29/2002	Thursday	7-9am & 3-5pm	5,870	3.14	18,459	327	6,036,945	SOUTH/WEST	0.33	0.20	0.00	0.00	0.00	0.00
0	0		0	0		5	4	3	1	1	30	41	57	124		6/20/2002	Thursday	7-9am & 3-5pm	5,502	3.14	17,302	327	5,658,479	BRIDG/HUME	0.35	0.21	0.06	0.04	0.06	0.04
0	0		0	0		0	0	0	0	0	215	221	209	211		6/20/2002	Thursday	6am-6pm*	12,581	1.23	15,475	327	5,060,885	CHALK/NEIL	0.39	0.24	0.00	0.00	0.00	0.00
0	0		0	0		2	2	1	1	1	85	90	127	130		3/25/1999	Thursday	8-9am & 2-4pm	3,073	4.17	12,804	327	4,187,526	GREEN/HURSL	0.47	0.29	0.08	0.05	0.08	0.05
2	0		1	0		1	1	2	2	2	129	130	91	93		7/18/2002	Thursday	7-9am & 3-5pm	1,312	3.14	4,126	327	1,349,314	ERIN /FITZP	1.45	0.89	0.73	0.44	0.48	0.30
2	0		1	0		2	3	4	3	2	100	75	47	69																



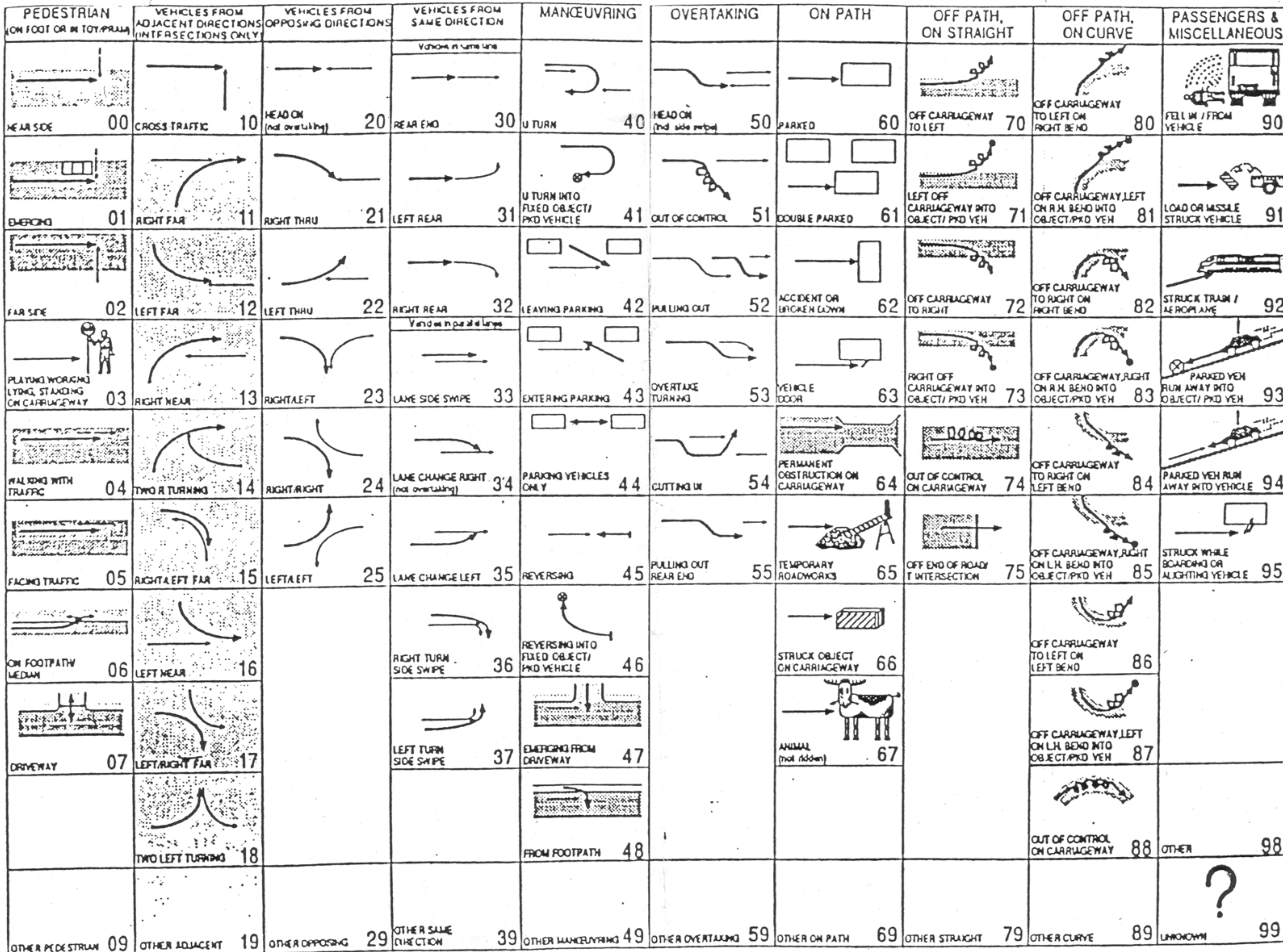
Frequency & Severity of Intersection Crashes
SEVERITY
No of Casualty Crashes (99-03)
FREQUENCY
No of Crashes (99 -03)
0
2
4
6
8
10
12
14
16
0
5
10
15
20
25
30
35
40
45
2 JAMES/WEST
1 BRIDGE/TOR
13 JAMES/NEIL
24 ALDERLEY/ANZAC
4 HURSLEY/TOR
3 HUME/JAMES
7 TAYLOR/TOR
39 JELLICOE/STUART
38 JELLICOE/RUTHVEN
19 BRIDGE/McDOUGALL
11 TAYLOR/WEST
8 BRIDGE/HOLBERTON
17 STEPHEN/WEST
36 RUTHVEN/SOUTH
20 BOUNDARY/BRIDGE
14 NORTH/RUTHVEN
32 MARGARET/WEST
29 DRAYTON/WEST
26 HURSLEY/McDOUGALL
46 JAMES/CLIFFORD
5 ALDERLEY/RUTHVEN
18 BRIDGE/RUTHVEN
41 JAMES/KITCHENER
42 ANZAC/STEPHEN
16 JAMES/WATER
9 JAMES/RUTHVEN
37 HERRIES/KITCHENER
21 HERRIES/RUTHVEN
15 ANZAC/JAMES
10 CLIFFORD/HERRIES
49 COHOE/HERRIES
30 COHOE/JAMES
25 ALDERLEY/DRAYTON
56 MACKENZIE/SOUTH
27 JAMES/PECHEY
23 STENNER/WEST
12 LONG/RUTHVEN
83 RUTHVEN/SPRING
43 CAMPBELL/RUTHVEN
6 RUTHVEN/STENNER
70 ROWBOTHAM/SOUTH
33 PERTH/RUTHVEN
FEDERAL
DMR
TCC
Black Spot Criteria



Casualty Crash Risk
No of Casualty Crashes per 10,000,000 Vehicles
Traffic Volume
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
32 GREENWATTLE/SOUTH
64 ALDERLEY/ROWBOTHAM
22 HURSLEY/McDOUGALL
2 BRIDGE/TOR
12 JELLICOE/RUTHVEN
6 ALDERLEY/ANZAC
93 ERIN/FITZPATRICK
63 GLENVALE/McDOUGALL
17 BOUNDARY/BRIDGE
3 JAMES/NEIL
11 BRIDGE/McDOUGALL
1 JAMES/WEST
10 BRIDGE/HOLBERTON
7 TAYLOR/TOR
5 HURSLEY/TOR
92 JELLICOE/MARY
16 RUTHVEN/SOUTH
62 GLENVALE/HAMPTON
15 NORTH/RUTHVEN
9 TAYLOR/WEST
4 HUME/JAMES
91 CURZON/HERRIES
30 HERRIES/KITCHENER
8 STEPHEN/WEST
61 ANZAC/CANNING
39 COHOE/JAMES
90 CAMPBELL/MARY
20 JAMES/CLIFFORD
29 ANZAC/STEPHEN
40 COHOE/HERRIES
28 CLIFFORD/HERRIES
19 ALDERLEY/RUTHVEN
59 CAMPBELL/HUME
36 ALDERLEY/DRAYTON
89 HUME/SPRING
27 JAMES/KITCHENER
38 ALDERLEY/HUME
26 BRIDGE/RUTHVEN
25 ANZAC/JAMES
23 JAMES/RUTHVEN
35 BRIDGE/McGREGOR
34 HUME/MARGARET
45 JAMES/PECHEY
84 RUTHVEN/SPRING
24 HERRIES/RUTHVEN
79 CAMPBELL/RUTHVEN
43 GEDDE/JAMES
76 ALDERLEY/WEST
75 RUSSELL/ANZAC & WEST
THVEN/STENNER
FEDERAL
DMR
TCC
Black Spot Criteria



Crash Risk
No of Crashes per 10,000,000 Vehicles
Traffic Volume
FEDERAL
DMR
TCC
Arbitrary Intervention Level
92 FITZPATRICK/TARA
71 HOGG/TOR
70 ROWBOTHAM/SOUTH
26 HURSLEY/McDOUGALL
99 ERIN/FITZPATRICK
69 CURZON/HERRIES
68 GREENWATTLE/SOUTH
91 GLENVALE/McDOUGALL
51 MORT/TAYLOR
90 CAMPBELL/MARY
89 NELSON/RUTHVEN
88 HUME/SPRING
34 MACKENZIE/MARGARET
20 BOUNDARY/BRIDGE
19 BRIDGE/McDOUGALL
30 COHOE/JAMES
58 DRAYTON/SOUTH
38 JELLICOE/RUTHVEN
49 COHOE/HERRIES
86 CAMPBELL/HUME
98 GREENWATTLE/HURSLEY
83 RUTHVEN/SPRING
95 SOUTH/WEST
94 BRIDGE/RICHMOND
1 BRIDGE/TOR
8 BRIDGE/HOLBERTON
14 NORTH/RUTHVEN
13 JAMES/NEIL
24 ALDERLEY/ANZAC
43 CAMPBELL/RUTHVEN
5 ALDERLEY/RUTHVEN
11 TAYLOR/WEST
7 TAYLOR/TOR
10 CLIFFORD/HERRIES
29 DRAYTON/WEST
35 BRIDGE/WEST
41 JAMES/KITCHENER
76 MARGARET/VICTORIA
75 HERRIES/NEIL
74 HERRIES/HUME
3 HUME/JAMES
4 HURSLEY/TOR
6 RUTHVEN/STENNER
18 BRIDGE/RUTHVEN
17 STEPHEN/WEST
27 JAMES/PECHEY
31 HUME/MARGARET
15 ANZAC/JAMES
40 GEDDES/JAMES
44 HERRIES/WEST
2 JAMES/WEST
9 JAMES/RUTHVEN
21 HERRIES/RUTHVEN



CODING OF ROAD USER MOVEMENTS

Appendix D – DMR sample Data Received

D

INCID_NO	SEVERITY	STREET1	STREET2	DATE	DAY	TIME	*ROAD_FEATU*
06/06018	Fatal	Unnamed Rd		9/03/2006	THU	9	99
06/02887	Hospitalised	Cambooya St	Parker St	4/02/2006	SAT	15	10
06/02893	Property damage	Glenvale Rd	Karrool St	4/02/2006	SAT	18	11
06/02772	Hospitalised	Platz St	Wuth St	3/02/2006	FRI	10	10
06/02811	Medical attn	Lilley St		3/02/2006	FRI	18	99
06/02700	Minor injury	Neil St	Warrego Hwy	2/02/2006	THU	15	10
06/02701	Property damage	Herries St	Kitchener St	2/02/2006	THU	16	10
06/02673	Hospitalised	Muir St		2/02/2006	THU	12	99
06/02616	Hospitalised	Ball St	Gipps St	1/02/2006	WED	17	10
06/02631	Property damage	New England Hwy		1/02/2006	WED	23	99
06/02665	Property damage	Mort St		1/02/2006	WED	9	99
06/02516	Minor injury	Campbell St	Mackenzie St	31/01/2006	TUE	18	10
06/02475	Medical attn	Gore Hwy (Prev Tmba-M'M		31/01/2006	TUE	9	99
06/02508	Medical attn	Mort St		31/01/2006	TUE	8	99
06/02509	Property damage	Burke St		31/01/2006	TUE	16	99
06/02511	Hospitalised	Bridge St		31/01/2006	TUE	17	99
06/02514	Hospitalised	Bridge St		31/01/2006	TUE	15	99
06/02499	Medical attn	Helen St	Warrego Hwy	30/01/2006	MON	14	10
06/02392	Hospitalised	Lemway Ave	Stenner St	30/01/2006	MON	8	11
06/02318	Hospitalised	Holberton St	Oakleigh St	29/01/2006	SUN	6	11
06/02250	Property damage	Taylor St	West St	28/01/2006	SAT	9	10
06/02298	Hospitalised	Bridge St	Gordon Ave	28/01/2006	SAT	21	10
06/02252	Hospitalised	Russell St	West St	28/01/2006	SAT	10	15
06/02128	Property damage	New England Hwy	Perth St	27/01/2006	FRI	7	10
06/02159	Property damage	New England Hwy	South St	27/01/2006	FRI	12	10
06/02173	Hospitalised	Greenwattle St	Warrego Hwy	27/01/2006	FRI	14	11
06/02109	Property damage	Glendower St	Jellicoe St	26/01/2006	THU	4	11
06/01807	Medical attn	Bridge St	West St	23/01/2006	MON	8	10
06/01728	Minor injury	Herries St	West St	22/01/2006	SUN	10	10
06/01535	Property damage	Hume St	Warrego Hwy	20/01/2006	FRI	13	10
06/01619	Minor injury	Long St	New England Hwy	20/01/2006	FRI	21	10
06/01641	Property damage	Warrego Hwy		20/01/2006	FRI	23	40
06/01450	Property damage	Stephen St	West St	19/01/2006	THU	15	10
06/01472	Property damage	Warrego Hwy		19/01/2006	THU	17	99
06/01079	Hospitalised	Warrego Hwy		15/01/2006	SUN	1	99
06/01022	Property damage	Hursley Rd	Silky-Oak Dr	14/01/2006	SAT	10	11

DCA_CODE	"NATURE_OF_"	HORIZONTAL	SPEED_LIMI	TRAFFIC_CO	DIVIDED_RO	"LONGITUDE"	LATITUDE
0	10	1	10	99	N	151.9468804	-27.56253988
101	2	1	60	9	N	151.9141243	-27.5956941
104	2	1	60	9	N	151.926517	-27.56755953
101	2	1	40	8	N	151.92948	-27.59711115
400	2	1	50	99	N	151.964754	-27.55629015
101	2	1	60	4	N	151.9531059	-27.57062525
202	2	1	60	4	N	151.9602624	-27.56756495
400	2	2	50	99	N	151.9569885	-27.54176949
101	2	1	60	8	N	151.91855	-27.59502782
703	6	1	60	99	N	151.9486937	-27.58313263
703	6	1	60	99	N	151.9428313	-27.54257162
101	2	1	50	8	Y	151.9707296	-27.55951584
301	3	1	60	99	N	151.9274147	-27.56919271
604	1	1	60	99	N	151.9484279	-27.55822979
704	2	1	60	99	N	151.9760162	-27.57295178
803	6	3	60	99	N	151.9499307	-27.55260541
307	3	1	60	99	N	151.9410496	-27.55151003
304	3	1	60	99	Y	151.937727	-27.56848132
303	3	1	60	9	N	151.9429589	-27.59411371
703	6	1	60	99	N	151.9346769	-27.54423936
101	2	1	60	4	N	151.9430325	-27.55737554
202	2	1	60	99	N	151.9372744	-27.55089433
100	2	1	60	9	N	151.9425762	-27.55937248
202	2	1	60	8	Y	151.9503569	-27.57413122
101	2	1	60	8	N	151.9492588	-27.5799659
104	2	1	60	8	Y	151.9181228	-27.54333776
703	6	1	60	99	N	151.9688383	-27.54963469
101	2	1	60	4	Y	151.9439754	-27.55179441
202	2	1	60	4	N	151.9417787	-27.56467276
202	2	1	60	4	Y	151.9553154	-27.57090332
101	2	1	60	4	N	151.9499335	-27.57617191
703	6	1	60	4	Y	151.9297286	-27.56759267
101	2	1	60	4	N	151.9401615	-27.57380366
301	3	1	60	99	Y	151.9331654	-27.56792216
805	7	2	60	99	Y	151.9804248	-27.56690047
303	3	1	60	99	N	151.9102442	-27.56044843

NUMBER_OF_	NO_FATALS	NO_HOSP	NO_MEDICAL	NO_MINOR	"UNIT1_DIRECTION"	"FATIGUE"	SPEED
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2	0	1	2	0	N	0	0
2	0	0	0	0	S	0	0
2	0	2	0	0	E	0	0
2	0	0	1	1	N	0	0
2	0	0	0	1	W	0	0
2	0	0	0	0	W	0	0
2	0	1	0	0	N	0	0
3	0	1	0	1	E	0	0
1	0	0	0	0	N	0	0
1	0	0	0	0	S	0	0
2	0	0	0	1	E	0	0
3	0	0	1	0	S	0	0
2	0	0	1	0	S	0	0
2	0	0	0	0	S	0	1
1	0	1	0	0	E	0	0
2	0	1	0	0	W	0	0
2	0	0	1	0	E	0	0
2	0	1	0	1	E	0	0
1	0	1	0	0	N	0	0
2	0	0	0	0	S	0	0
2	0	1	0	0	W	0	0
2	0	1	0	0	N	0	0
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2	0	0	0	0	N	0	0
2	0	0	0	0	W	0	0
1	0	1	0	0	E	0	0
2	0	0	0	0	E	0	0

ALCOHOL	WET_ROAD	"CAR_UTE"	RIGID_TRUCK	ART_TRUCK	BUS	MOTORCYCLE	TRACTOR	"BICYCLE"
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0	0	1	1	0	0	0	0	0
0	0	2	0	0	0	0	0	0
0	0	1	1	0	0	0	0	0
0	0	2	0	0	0	0	0	0
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0	0	1	0	0	0	1	0	0
0	0	3	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0
0	0	2	0	0	0	0	0	0
0	0	3	0	0	0	0	0	0
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0	0	2	0	0	0	0	0	0
0	0	2	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0
0	0	2	0	0	0	0	0	0

PEDESTRIAN	"SEV_CODE"	Year	Month	RSECT_ID	INTER	TDIST
1	1	2006	Mar		0	0
0	2	2006	Feb	321	0	0.23
0	5	2006	Feb		0	0
0	2	2006	Feb		0	0
0	3	2006	Feb		0	0
0	4	2006	Feb	18A	0	94.76
0	5	2006	Feb		0	0
0	2	2006	Feb		0	0
0	2	2006	Feb		0	0
0	5	2006	Feb	22B	0	1.455
0	5	2006	Feb		0	0
0	4	2006	Jan		0	0
0	3	2006	Jan	28A	0	0.21
0	3	2006	Jan		0	0
0	5	2006	Jan		0	0
0	2	2006	Jan		0	0
0	2	2006	Jan		0	0
0	3	2006	Jan	18B	0	1.32
0	2	2006	Jan		0	0
0	2	2006	Jan		0	0
0	5	2006	Jan		0	0
0	2	2006	Jan		0	0
0	2	2006	Jan		0	0
0	5	2006	Jan	22B	498	0.43
0	5	2006	Jan	22B	0	1.08
0	2	2006	Jan	18B	0	5.785
0	5	2006	Jan		0	0
0	3	2006	Jan		0	0
0	4	2006	Jan		0	0
0	5	2006	Jan	18A	0	94.58
0	4	2006	Jan	22B	0	0.66
0	5	2006	Jan	18B	0	1.95
0	5	2006	Jan		0	0
0	5	2006	Jan	18B	0	1.805
0	2	2006	Jan	18A	0	91.5
0	5	2006	Jan		0	0

QDMR Table of Codes

Feature Of Roadway Code Description	"ROAD_FEATU"
10	Cross
11	T junction
12	Y junction
13	Multiple Road
14	Interchange
15	Roundabout
20	Bridge, Causeway
30	Railway Crossing
40	Median Opening
50	Merge Lane
90	Miscellaneous
99	Not Applicable

Traffic Control	"TRAFFIC_CO"
1	Police
2	Road/Rail worker
3	School cross superviser
4	Operating traffic lights
5	Flashing amber lights
6	Railway lights only
7	Boom gate
8	Stop sign
9	Give way sign
10	Rail cross sign
11	Ped. Crossing
12	School cross flags
90	Misc
99	No traffic control

Nature of Crash	"NATURE_OF"
1	Hit parked vehicle
2	Angle
3	Rear end
4	Head-on
5	Sideswipe
6	Hit fixed obstruction or temp. objec
7	Overturned
8	Fall from moving veh.
9	Cycle fall or drop
10	Hit pedestrian
11	Hit animal
12	Struck by external load
13	Struck by internal load
91	Collision misc.
92	Non Collision misc.

Serverity of Injury	"SEV_CODE"
1	Fatal
2	Admitted to Hospital
3	Received medical treatment - not admitted
4	Minor injury - first aid or no treatment
5	Property damage only

Horizontal roadway Alignment	"Horizontal"
1	Straight
2	Curved view obscured
3	Curved view open

Appendix E – Alternate Intersection Classification System

E

Alternate Intersection Classification

Intersection Input

↓

Road Categories (Additive)

	A	S	T	L
A	80	70	60	50
S	70	60	50	40
T	60	50	40	30
L	50	40	30	20

↓

Intersection Codes (Additive)

	80	70	60	50	40	30	20
O	85	75	65	55	45	35	25
T	90	80	70	60	50	40	30
Y	100	90	80	70	60	50	40
+	110	100	90	80	70	60	50
*****	120	110	100	90	80	70	60

↓

Control	Add
LP	5
LP	10
S	20
G	30
N	40

= **Intersection Classification Score**

Legends

Road Hierarchy

			Add Score
A	Arterial		40
S	Sub-Arterial		30
T	Trunk Collector		20
L	Local Collector		10

Intersection Type
(Multi varies)

		Major Conflicts	Add Score
O	Roundabout	4	5
T	T junction	6	10
Y	Y junction	6	20
+	Cross	24	30
*****	Multi junction	24-36	40

Intersection Control

			Add Score
LP	Signals, protected turns		5
LP	Signals		10
S	Stop Sign		20
G	Give Way		30
N	None		40

Possible Score Ranges
* Some scores are not possible

30	56
56	82
83	108
109	134
135	160

Intersection Classification (5 Tier)

Intersection Input

Road Categories

	A	S	D	C	L
A	○	□	◊	◊	
S	□	○	□	◊	◊
D	◊	□	○	□	◊
C	◊	◊	□	○	□
L		◊	◊	□	○

Intersection Codes

	AA	SS	DD	CC	LL	AS	AD	AC	SD	SC	SL	DC	DL	CL
O	O.AA	O.SS	O.DD	O.CC	O.LL	O.AS	O.AD	O.AC	O.SD	O.SC	O.SL	O.DC	O.DL	O.CL
X	X.AA	X.SS	X.DD	X.CC	X.LL	X.AS	X.AD	X.AC	X.SD	X.SC	X.SL	X.DC	X.DL	X.CL
Y	Y.AA	Y.SS	Y.DD	Y.CC	Y.LL	Y.AS	Y.AD	Y.AC	Y.SD	Y.SC	Y.SL	Y.DC	Y.DL	Y.CL
T	T.AA	T.SS	T.DD	T.CC	T.LL	T.AS	T.AD	T.AC	T.SD	T.SC	T.SL	T.DC	T.DL	T.CL
*****	*.AA	*.SS	*.DD	*.CC	*.LL	*.AS	*.AD	*.AC	*.SD	*.SC	*.SL	*.DC	*.DL	*.CL

Legend

Appropriate & Inappropriate Intersections

- ○ Appropriate for intersections between roads of the same function
- □ Generally appropriate for intersections between roads of different functions
- ◊ Undesirable to have an intersection

Road Hierarchy

- **A** Arterial
- **S** Sub-Arterial
- **D** Distributor
- **C** Collector
- **L** Local

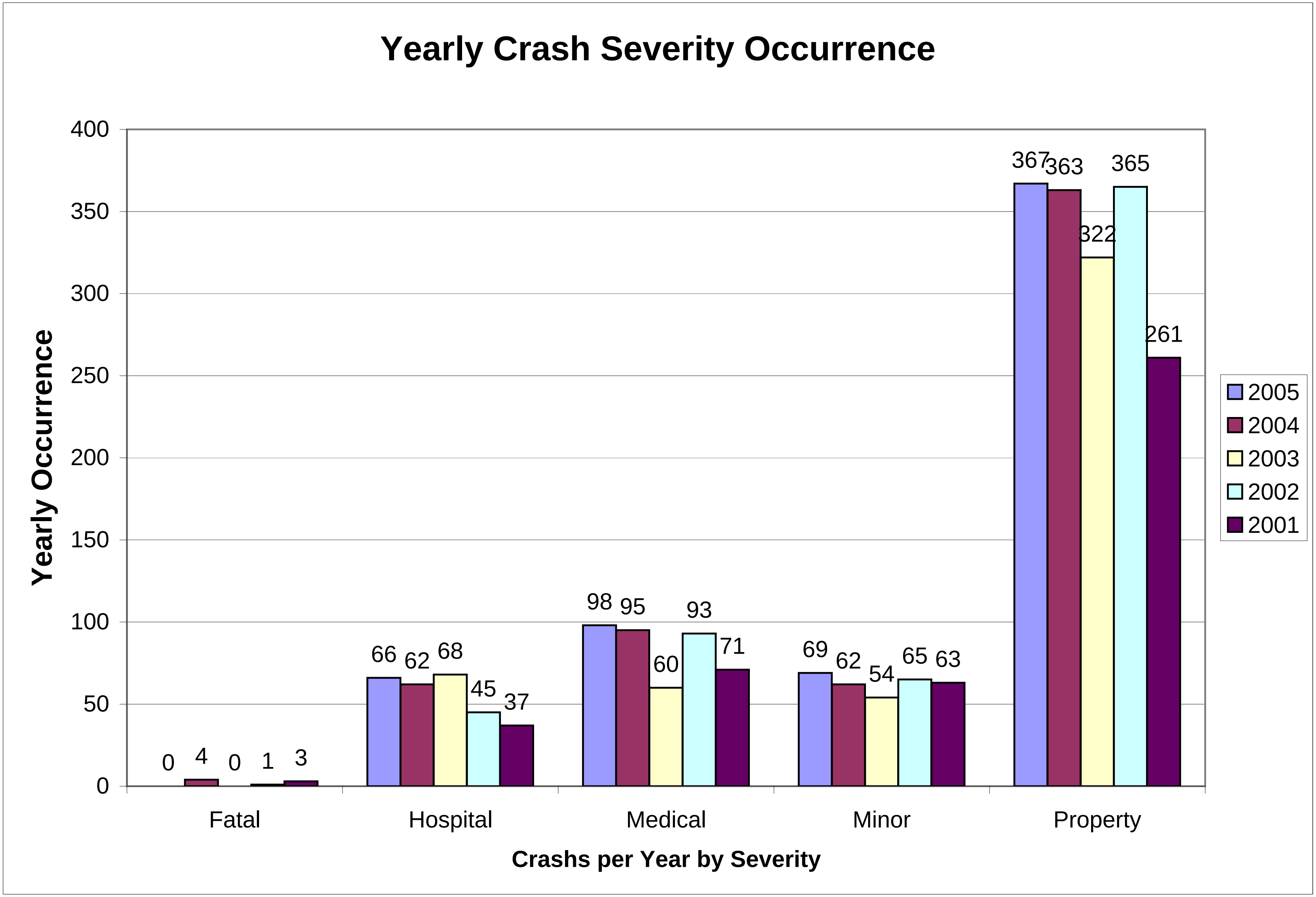
Intersection Type

- **O** Roundabout
- **X** Cross
- **Y** Y junction
- **T** T junction
- ***** Multi

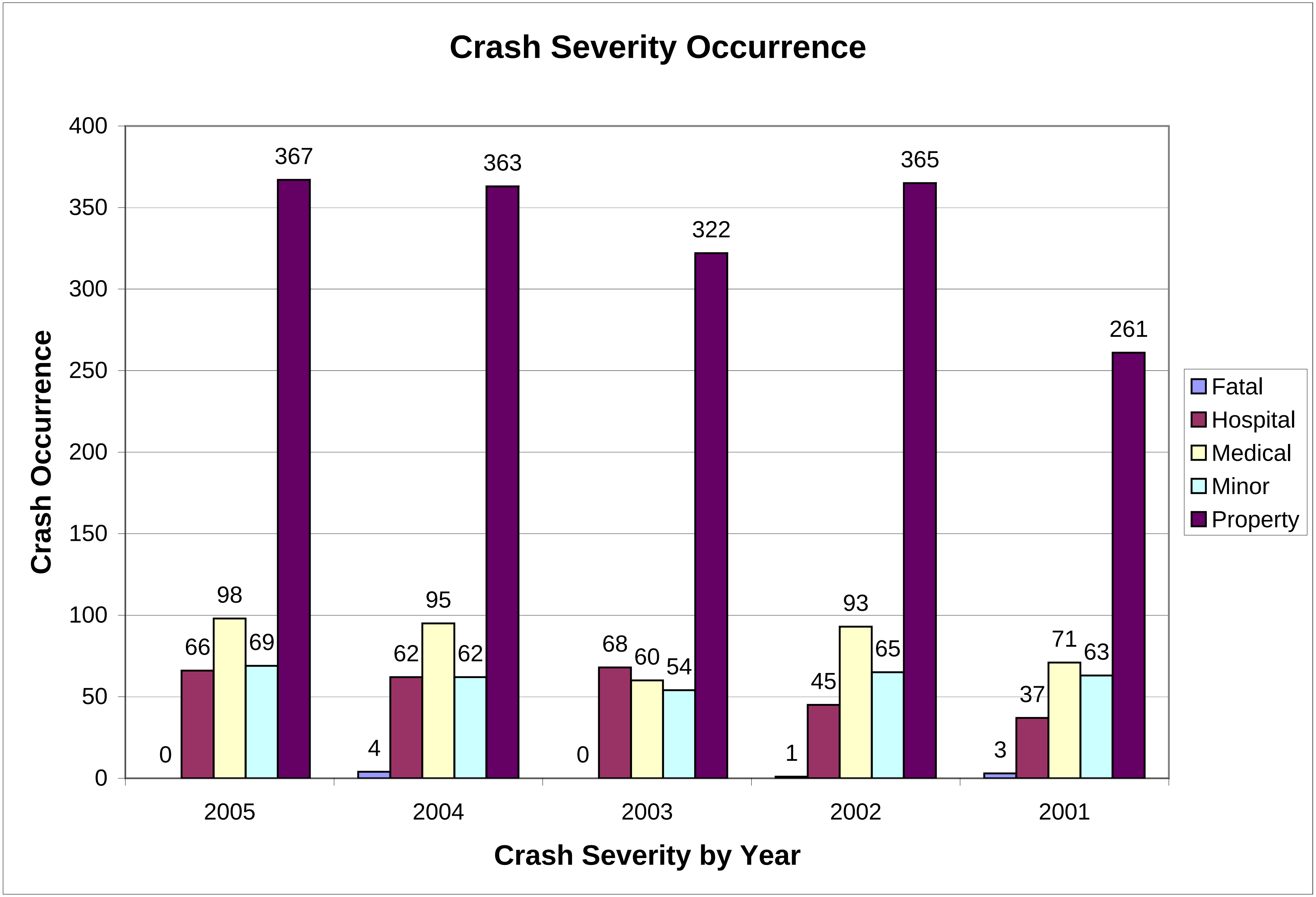
AAO	A	A	O	Arterial	Arterial	Roundabout	Arterial-Arterial.Roundabout
AA+	A	A	+	Arterial	Arterial	Cross	Arterial-Arterial.Cross
AAY	A	A	Y	Arterial	Arterial	Multi/Y junction	Arterial-Arterial.Multi/Y junction
AAT	A	A	T	Arterial	Arterial	T junction	Arterial-Arterial.T junction
SSO	S	S	O	Sub-Arterial	Sub-Arterial	Roundabout	Sub-Arterial-Sub-Arterial.Roundabout
SS+	S	S	+	Sub-Arterial	Sub-Arterial	Cross	Sub-Arterial-Sub-Arterial.Cross
SSY	S	S	Y	Sub-Arterial	Sub-Arterial	Multi/Y junction	Sub-Arterial-Sub-Arterial.Multi/Y junction
SST	S	S	T	Sub-Arterial	Sub-Arterial	T junction	Sub-Arterial-Sub-Arterial.T junction
TTO	T	T	O	Trunk Collector	Trunk Collector	Roundabout	Trunk Collector-Trunk Collector.Roundabout
TT+	T	T	+	Trunk Collector	Trunk Collector	Cross	Trunk Collector-Trunk Collector.Cross
TTY	T	T	Y	Trunk Collector	Trunk Collector	Multi/Y junction	Trunk Collector-Trunk Collector.Multi/Y junction
TTT	T	T	T	Trunk Collector	Trunk Collector	T junction	Trunk Collector-Trunk Collector.T junction
LLO	L	L	O	Arterial	Arterial	Roundabout	Arterial-Arterial.Roundabout
LL+	L	L	+	Arterial	Arterial	Cross	Arterial-Arterial.Cross
LLY	L	L	Y	Arterial	Arterial	Multi/Y junction	Arterial-Arterial.Multi/Y junction
LLT	L	L	T	Arterial	Arterial	T junction	Arterial-Arterial.T junction
ASO	A	S	O	Arterial	Sub-Arterial	Roundabout	Arterial-Sub-Arterial.Roundabout
AS+	A	S	+	Arterial	Sub-Arterial	Cross	Arterial-Sub-Arterial.Cross
ASY	A	S	Y	Arterial	Sub-Arterial	Multi/Y junction	Arterial-Sub-Arterial.Multi/Y junction
AST	A	S	T	Arterial	Sub-Arterial	T junction	Arterial-Sub-Arterial.T junction
ATO	A	T	O	Arterial	Trunk Collector	Roundabout	Arterial-Trunk Collector.Roundabout
AT+	A	T	+	Arterial	Trunk Collector	Cross	Arterial-Trunk Collector.Cross
ATY	A	T	Y	Arterial	Trunk Collector	Multi/Y junction	Arterial-Trunk Collector.Multi/Y junction
ATT	A	T	T	Arterial	Trunk Collector	T junction	Arterial-Trunk Collector.T junction
ALO	A	L	O	Arterial	Arterial	Roundabout	Arterial-Arterial.Roundabout
AL+	A	L	+	Arterial	Arterial	Cross	Arterial-Arterial.Cross
ALY	A	L	Y	Arterial	Arterial	Multi/Y junction	Arterial-Arterial.Multi/Y junction
ALT	A	L	T	Arterial	Arterial	T junction	Arterial-Arterial.T junction
STO	S	T	O	Sub-Arterial	Trunk Collector	Roundabout	Sub-Arterial-Trunk Collector.Roundabout
ST+	S	T	+	Sub-Arterial	Trunk Collector	Cross	Sub-Arterial-Trunk Collector.Cross
STY	S	T	Y	Sub-Arterial	Trunk Collector	Multi/Y junction	Sub-Arterial-Trunk Collector.Multi/Y junction
STT	S	T	T	Sub-Arterial	Trunk Collector	T junction	Sub-Arterial-Trunk Collector.T junction
SLO	S	L	O	Sub-Arterial	Arterial	Roundabout	Sub-Arterial-Arterial.Roundabout
SL+	S	L	+	Sub-Arterial	Arterial	Cross	Sub-Arterial-Arterial.Cross
SLY	S	L	Y	Sub-Arterial	Arterial	Multi/Y junction	Sub-Arterial-Arterial.Multi/Y junction
SLT	S	L	T	Sub-Arterial	Arterial	T junction	Sub-Arterial-Arterial.T junction
TLO	T	L	O	Trunk Collector	Arterial	Roundabout	Trunk Collector-Arterial.Roundabout
TL+	T	L	+	Trunk Collector	Arterial	Cross	Trunk Collector-Arterial.Cross
TLY	T	L	Y	Trunk Collector	Arterial	Multi/Y junction	Trunk Collector-Arterial.Multi/Y junction
TLT	T	L	T	Trunk Collector	Arterial	T junction	Trunk Collector-Arterial.T junction

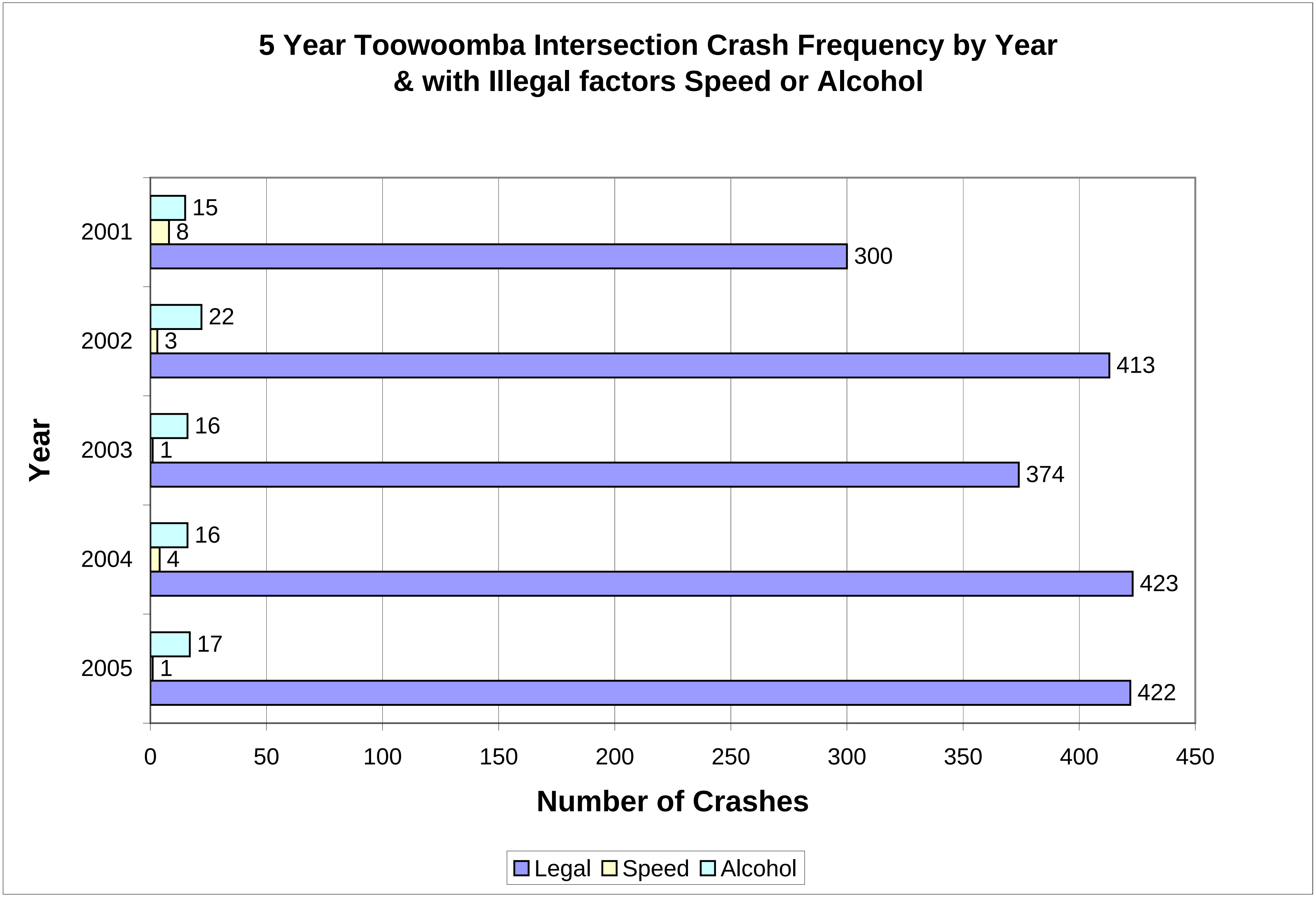
Appendix F – Five Year Data Charts

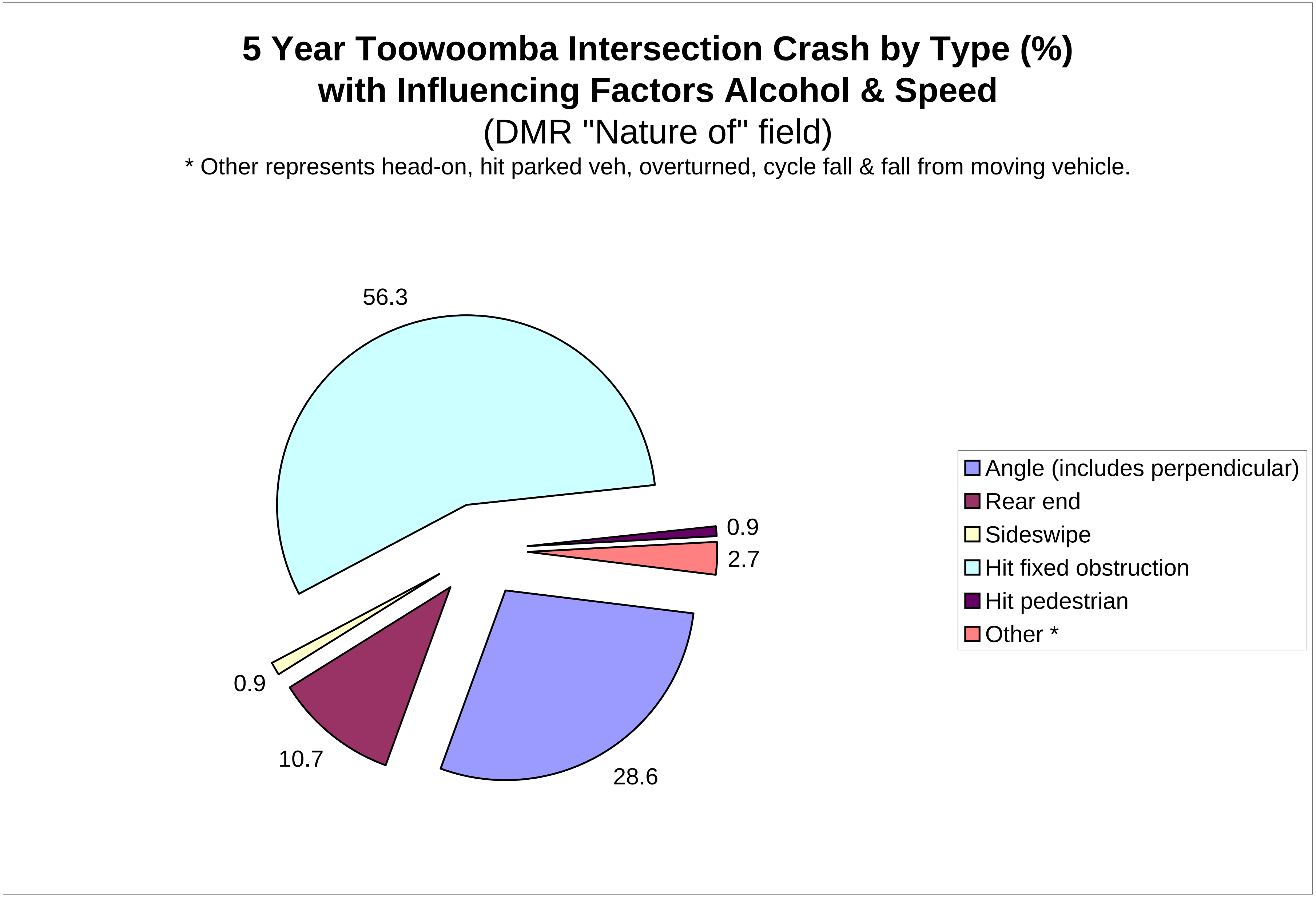
F

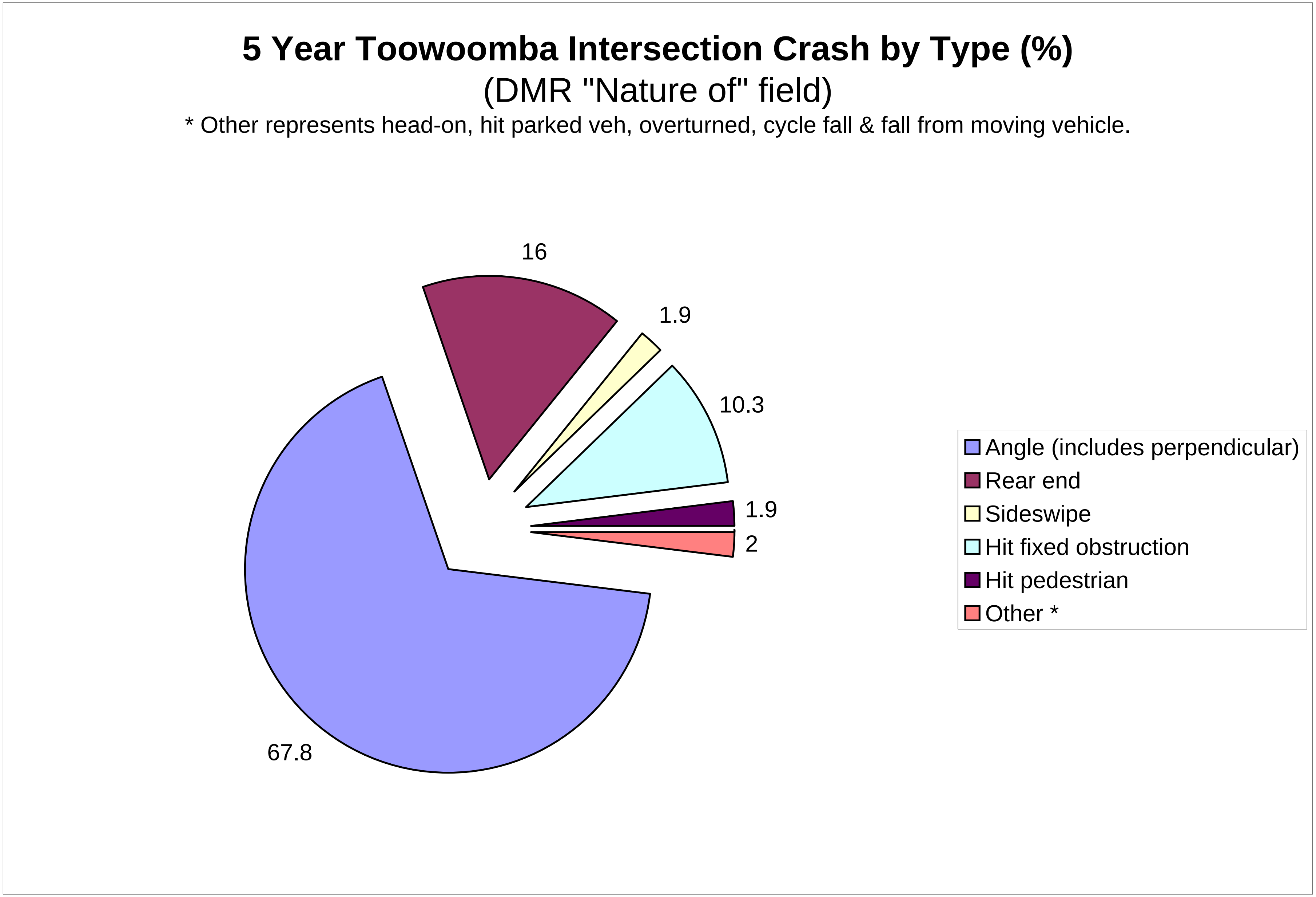


Yearly Crash Severity Occurrence
Yearly Occurrence
400
350
300
250
200
150
100
50
0
0
4
0
1
3
66
62
68
45
37
98
95
60
93
71
69
62
54
65
63
367
363
322
365
261
Fatal
Hospital
Medical
Minor
Property
Crashs per Year by Severity
2005
2004
2003
2002
2001

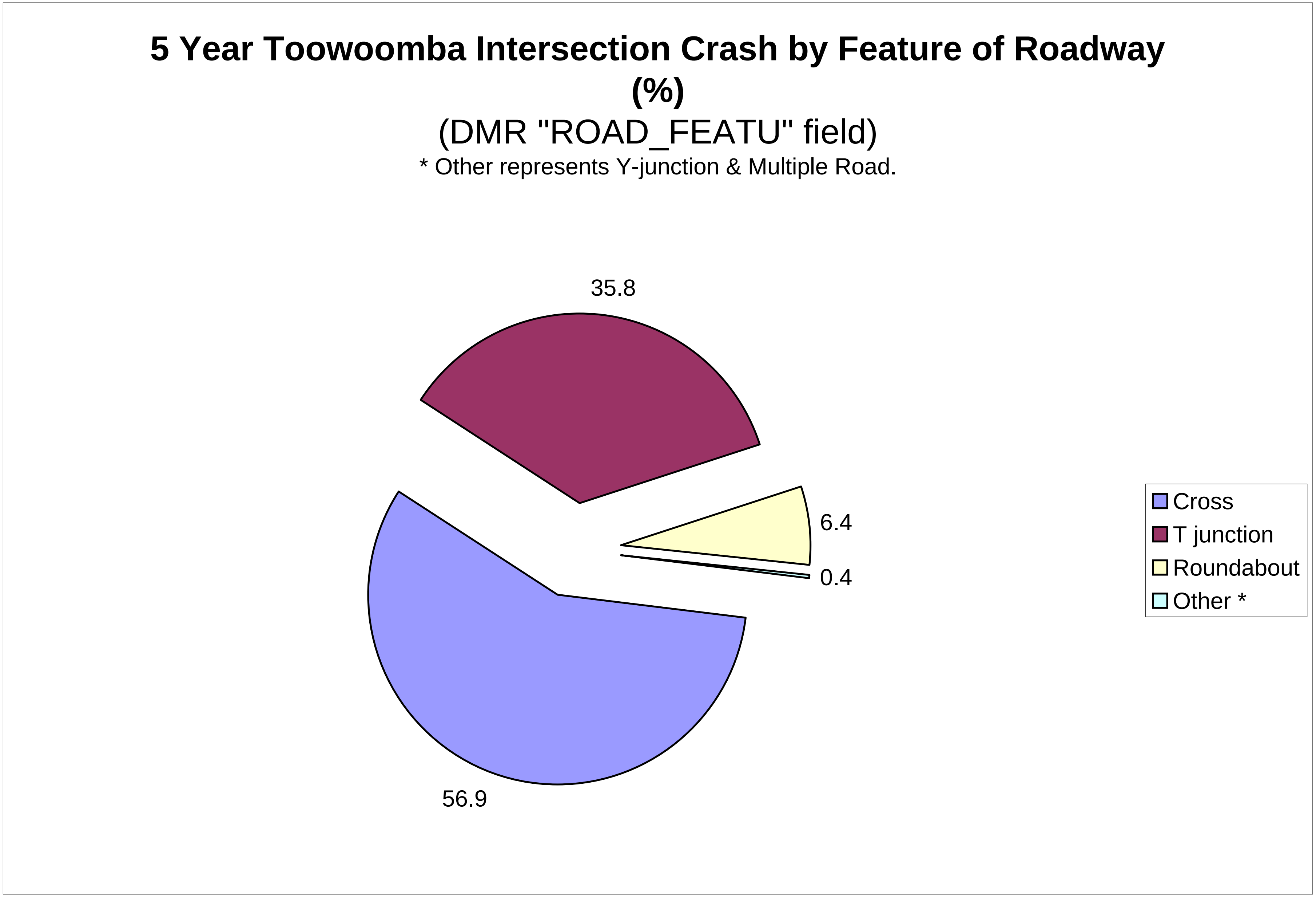

Crash Severity Occurrence
Crash Occurrence
400
350
300
250
200
150
100
50
0
367
363
322
365
261
98
66
69
95
62
62
68
60
54
93
45
65
71
37
63
0
4
0
1
3
2005
2004
2003
2002
2001
Crash Severity by Year
Fatal
Hospital
Medical
Minor
Property

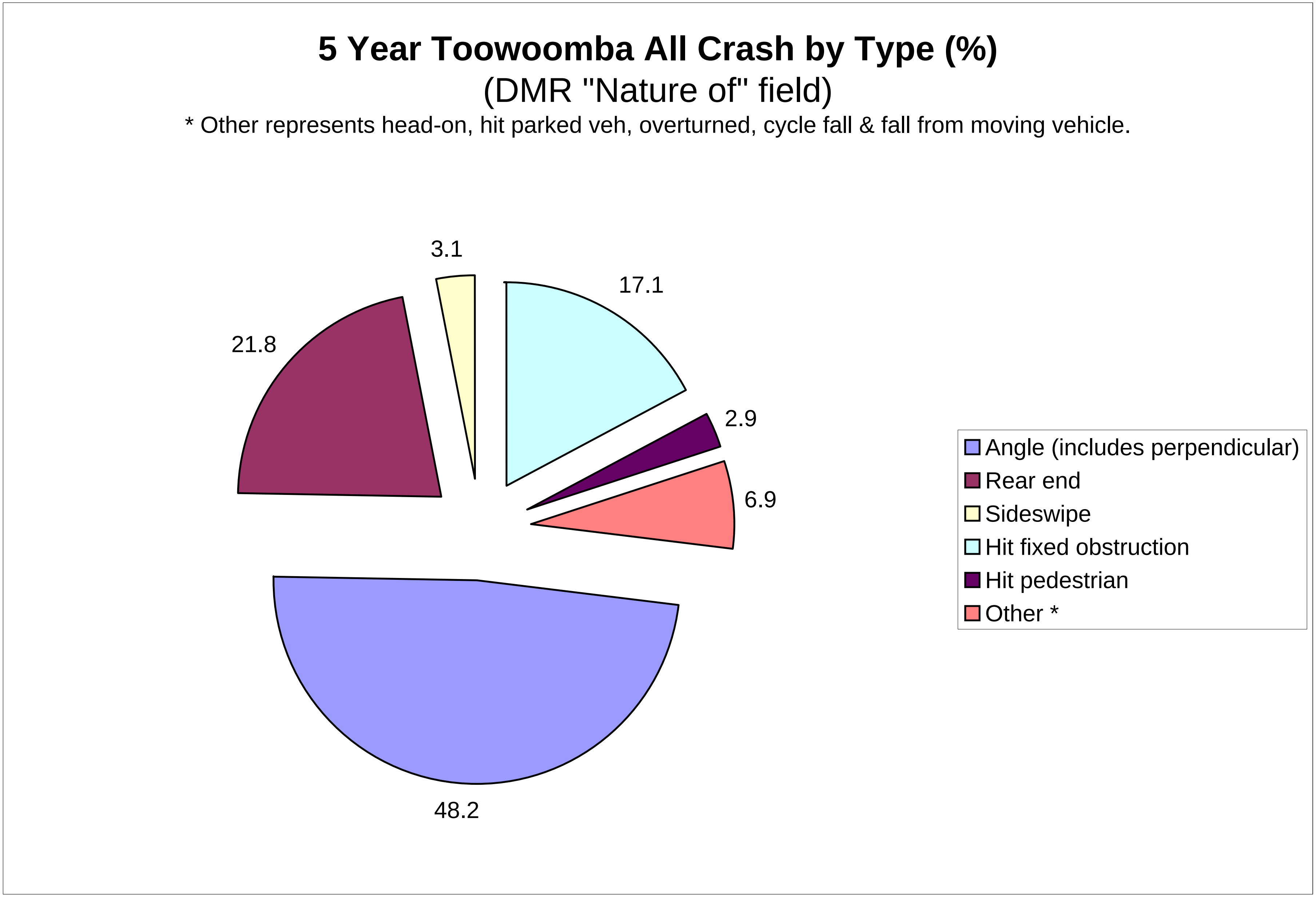

5 Year Toowoomba Intersection Crash Frequency by Year
& with Illegal factors Speed or Alcohol
Year
2001
2002
2003
2004
2005
15
8
300
22
3
413
16
1
374
16
4
423
17
1
422
0
50
100
150
200
250
300
350
400
450
Number of Crashes
Legal
Speed
Alcohol

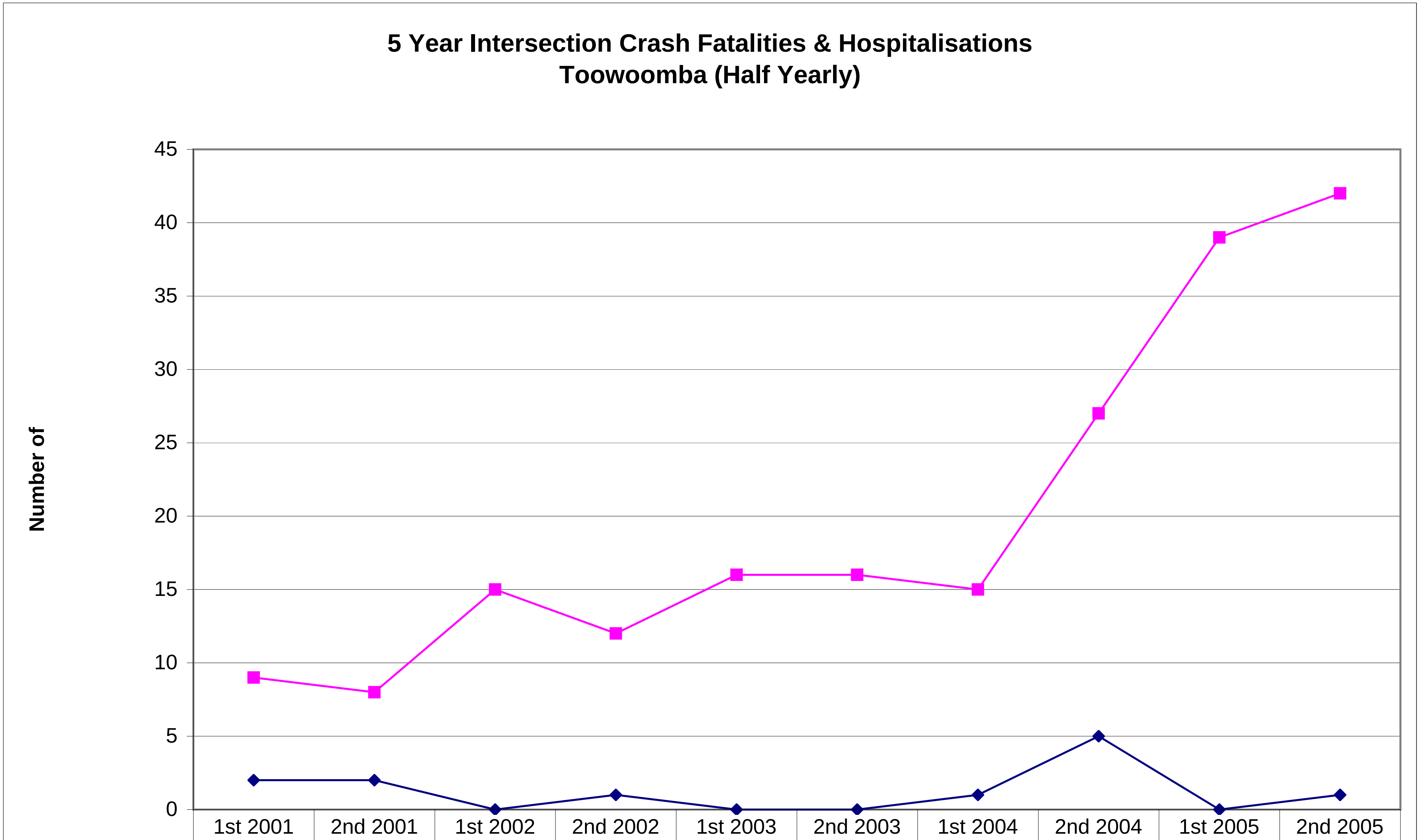

5 Year Toowoomba Intersection Crash by Type (%)
with Influencing Factors Alcohol & Speed
(DMR "Nature of" field)
* Other represents head-on, hit parked veh, overturned, cycle fall & fall from moving vehicle.
56.3
0.9
2.7
0.9
10.7
28.6
Angle (includes perpendicular)
Rear end
Sideswipe
Hit fixed obstruction
Hit pedestrian
Other *



5 Year Toowoomba Intersection Crash by Type (%)
(DMR "Nature of" field)
* Other represents head-on, hit parked veh, overturned, cycle fall & fall from moving vehicle.
16
1.9
10.3
1.9
2
67.8
Angle (includes perpendicular)
Rear end
Sideswipe
Hit fixed obstruction
Hit pedestrian
Other *


5 Year Toowoomba Intersection Crash by Feature of Roadway (%)
(DMR "ROAD_FEATU" field)
* Other represents Y-junction & Multiple Road.
35.8
6.4
0.4
56.9
Cross
T junction
Roundabout
Other *


5 Year Toowoomba All Crash by Type (%)
(DMR "Nature of" field)
* Other represents head-on, hit parked veh, overturned, cycle fall & fall from moving vehicle.
3.1
17.1
21.8
2.9
6.9
48.2
Angle (includes perpendicular)
Rear end
Sideswipe
Hit fixed obstruction
Hit pedestrian
Other *



	1st 2001	2nd 2001	1st 2002	2nd 2002	1st 2003	2nd 2003	1st 2004	2nd 2004	1st 2005	2nd 2005
Fatal	2	2	0	1	0	0	1	5	0	1
Hospital	9	8	15	12	16	16	15	27	39	42

Appendix G – Intersection Profiles

G

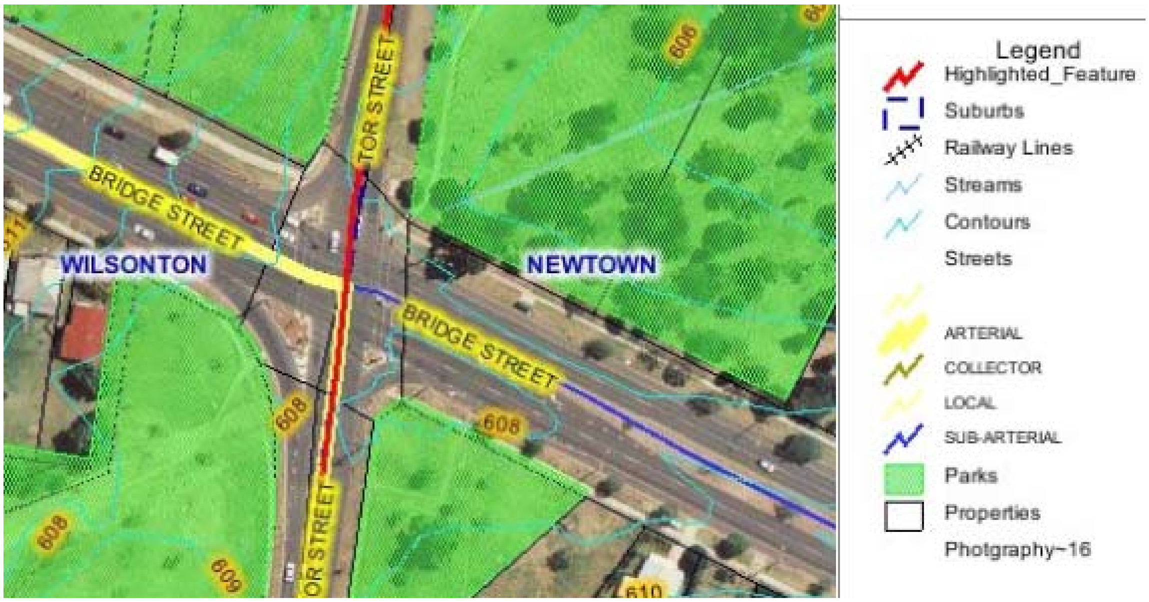
ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
1/02/2003	11:55	BRIDGE ST	TOR ST	0	1	30W
10/08/2001	11:25	BRIDGE ST	TOR ST	0	1	21E
11/02/2004	19:45	BRIDGE ST	TOR ST	0	1	10S
13/07/2004	8:30	BRIDGE ST	TOR ST	0	1	31N
13/12/2003	20:45	BRIDGE ST	TOR ST	0	2	21S
28/05/2002	10:15	BRIDGE ST	TOR ST	0	0	21E
28/05/2002	18:20	BRIDGE ST	TOR ST	0	0	21S
28/08/2002	16:00	BRIDGE ST	TOR ST	0	0	21E
28/08/2002	16:00	BRIDGE ST	TOR ST	0	0	21E
30/04/2001	7:15	BRIDGE ST	TOR ST	0	1	10N
30/04/2004	10:15	BRIDGE ST	TOR ST	0	1	21E
30/06/2002	12:50	BRIDGE ST	TOR ST	0	0	10N
30/08/2001	10:25	BRIDGE ST	TOR ST	0	0	31N
30/08/2002	16:20	BRIDGE ST	TOR ST	0	0	32E
31/01/2003	7:50	BRIDGE ST	TOR ST	0	0	31N
4/03/2004	14:00	BRIDGE ST	TOR ST	0	0	21S
4/07/2002	15:30	BRIDGE ST	TOR ST	0	2	31N
6/11/2001	11:30	BRIDGE ST	TOR ST	0	0	31N
7/10/2005	12:20	BRIDGE ST	TOR ST	0	0	21N
9/12/2004	19:15	BRIDGE ST	TOR ST	0	0	21S

NOTES:

Wet Crash- 0%
% of Cars - 95%
% of Mtr Bke - 0%

Rank 1 **AA+**
Fault car dir. Random
Speed Limit 60 km/h
Traffic Control signals

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
8/22/2001	Wednesday	6am-6pm*	19,513	1.23	24,001	349



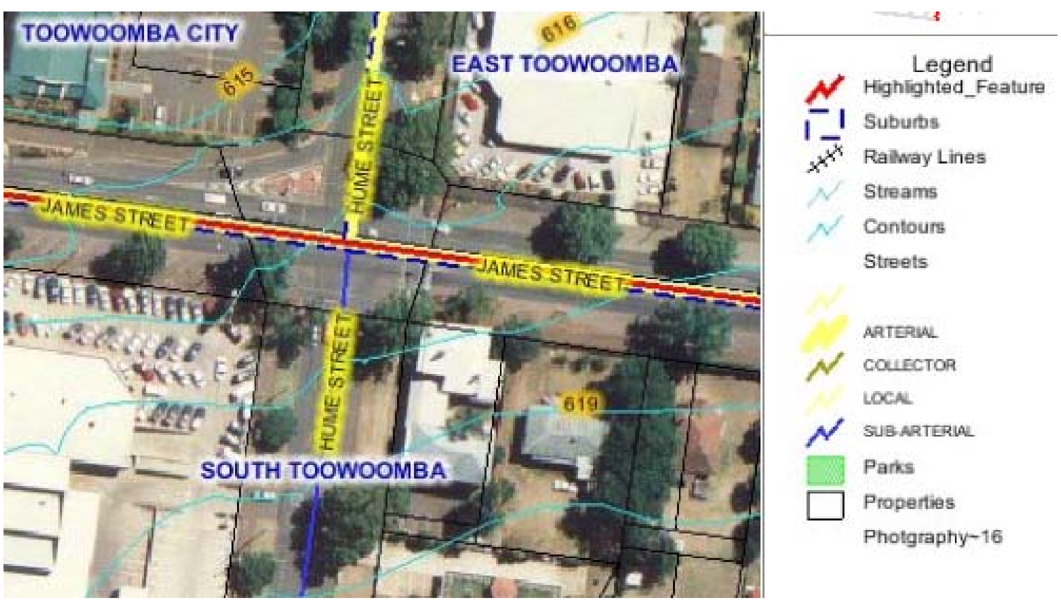
ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR	RUMDESC
30/08/2004	7:40	HUME ST	JAMES ST	0	1	21W	VEHICLES FROM
30/06/2003	14:00	HUME ST	JAMES ST	0	0	10S	AT INTERSECTION
30/05/2003	21:30	HUME ST	JAMES ST	0	3	10S	AT INTERSECTION
3/08/2002	14:40	HUME ST	JAMES ST	0	0	30E	VEHICLES FROM
3/04/2003	15:45	HUME ST	JAMES ST	0	0	30W	VEHICLES FROM
28/07/2002	21:24	HUME ST	JAMES ST	0	0	31N	VEHICLES FROM
27/09/2003	10:15	HUME ST	JAMES ST	0	0	21E	VEHICLES FROM
26/08/2002	17:15	HUME ST	JAMES ST	0	1	10N	AT INTERSECTION
26/07/2001	11:15	HUME ST	JAMES ST	0	0	85E	CURVE OFF
24/02/2004	14:45	HUME ST	JAMES ST	0	0	21E	VEHICLES FROM
22/12/2002	22:25	HUME ST	JAMES ST	0	0	10N	AT INTERSECTION
22/01/2002	16:00	HUME ST	JAMES ST	0	0	30E	VEHICLES FROM
21/07/2005	14:20	HUME ST	JAMES ST	0	0	30N	VEHICLES FROM
21/07/2004	16:50	HUME ST	JAMES ST	0	0	34S	VEHICLES FROM
19/09/2003	13:50	HUME ST	JAMES ST	0	2	10E	AT INTERSECTION
19/07/2004	18:15	HUME ST	JAMES ST	0	0	21E	VEHICLES FROM
18/02/2002	10:15	HUME ST	JAMES ST	0	0	21W	VEHICLES FROM
17/10/2003	5:00	HUME ST	JAMES ST	0	1	10N	AT INTERSECTION
16/09/2002	8:30	HUME ST	JAMES ST	0	0	10W	AT INTERSECTION
16/04/2003	10:45	HUME ST	JAMES ST	0	1	21W	VEHICLES FROM
16/04/2003	15:15	HUME ST	JAMES ST	0	0	30E	VEHICLES FROM
15/10/2004	16:30	HUME ST	JAMES ST	0	0	21S	VEHICLES FROM
15/01/2004	20:05	HUME ST	JAMES ST	0	0	16E	AT INTERSECTION
14/09/2003	20:15	HUME ST	JAMES ST	0	0	32E	VEHICLES FROM
12/07/2002	20:30	HUME ST	JAMES ST	0	0	10W	AT INTERSECTION

NOTES:

Wet Crash- 0%
% of Cars - 93%
% of Mtr Bke - 2%

Rank 3 **AA+**
Fault car dir. Random
Speed Limit 60 km/h
Traffic Control signals

A - 24 COUNT DATE	DAY	DURATIO N	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F	ANNUAL VOL
2/14/2002	Thursday	6am-6pm*	24,131	1.23	29,681	327	9,707,036



Source: TCC ATLIS (Website)

ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
9/05/2003	15:20	LONG ST	RUTHVEN ST	0	1	00W
6/11/2004	18:30	LONG ST	RUTHVEN ST	0	0	10E
6/06/2003	15:30	LONG ST	RUTHVEN ST	0	0	01S
4/02/2003	20:40	LONG ST	RUTHVEN ST	0	0	30N
30/12/2004	11:30	LONG ST	RUTHVEN ST	0	0	21S
30/01/2001	15:30	LONG ST	RUTHVEN ST	0	0	21E
3/12/2004	0:15	LONG ST	RUTHVEN ST	0	0	31S
3/10/2005	11:50	LONG ST	RUTHVEN ST	0	0	10N
3/03/2004	8:45	LONG ST	RUTHVEN ST	0	0	32W
29/08/2002	15:45	LONG ST	RUTHVEN ST	0	0	10E
29/01/2004	19:50	LONG ST	RUTHVEN ST	0	0	10N
28/07/2002	17:15	LONG ST	RUTHVEN ST	0	0	32N
28/05/2003	10:00	LONG ST	RUTHVEN ST	0	2	21N
28/04/2003	16:20	LONG ST	RUTHVEN ST	0	0	30N
28/04/2002	19:10	LONG ST	RUTHVEN ST	0	0	10N
26/04/2002	8:15	LONG ST	RUTHVEN ST	0	0	21N
21/05/2004	12:15	LONG ST	RUTHVEN ST	0	0	21N
2/08/2005	18:10	LONG ST	RUTHVEN ST	0	0	10E
18/12/2003	20:40	LONG ST	RUTHVEN ST	0	1	21S
18/08/2004	6:15	LONG ST	RUTHVEN ST	0	1	10E
17/09/2005	9:30	LONG ST	RUTHVEN ST	0	0	30N
16/11/2001	20:34	LONG ST	RUTHVEN ST	0	0	10S
13/04/2004	10:20	LONG ST	RUTHVEN ST	0	0	21N
11/07/2002	18:30	LONG ST	RUTHVEN ST	0	0	21N

NOTES:

Wet Crash- 5%
% of Cars - 92%
% of Mtr Bke - 0%

Rank 12 **LA+.**
Fault car dir. Random
Speed Limit 60 km/h
Traffic Control signals

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
4/2/2003	Wednesda	6am-6pm*	20,270	1.23	24,932	349

Source: TCC ATLIS (Website)

ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
6/4/2002	14:30	ANZAC AVE	JAMES ST	0	0	21S
30/12/2002	16:10	ANZAC AVE	JAMES ST	0	0	21W
30/09/2003	9:05	ANZAC AVE	JAMES ST	0	0	35W
3/7/2001	12:00	ANZAC AVE	JAMES ST	0	0	21S
29/06/2004	13:45	ANZAC AVE	JAMES ST	0	2	30W
28/10/2003	15:50	ANZAC AVE	JAMES ST	0	1	21W
26/05/2002	14:00	ANZAC AVE	JAMES ST	0	1	31S
24/05/2004	19:15	ANZAC AVE	JAMES ST	0	0	21S
23/08/2004	14:20	ANZAC AVE	JAMES ST	0	0	10E
21/05/2004	15:30	ANZAC AVE	JAMES ST	0	0	21S
2/09/2005	12:42	ANZAC AVE	JAMES ST	0	1	21S
18/04/2001	10:50	ANZAC AVE	JAMES ST	0	0	02E
17/10/2003	16:45	ANZAC AVE	JAMES ST	0	1	30N
15/08/2005	10:15	ANZAC AVE	JAMES ST	0	1	30N
15/08/2005	10:30	ANZAC AVE	JAMES ST	0	0	21S
14/06/2003	19:05	ANZAC AVE	JAMES ST	0	0	21W
13/12/2003	16:30	ANZAC AVE	JAMES ST	0	0	35N
12/10/2001	19:55	ANZAC AVE	JAMES ST	0	0	32E
12/04/2005	15:26	ANZAC AVE	JAMES ST	0	1	02N
11/10/2003	9:10	ANZAC AVE	JAMES ST	0	0	21W
11/08/2001	19:50	ANZAC AVE	JAMES ST	0	0	21S

NOTES:

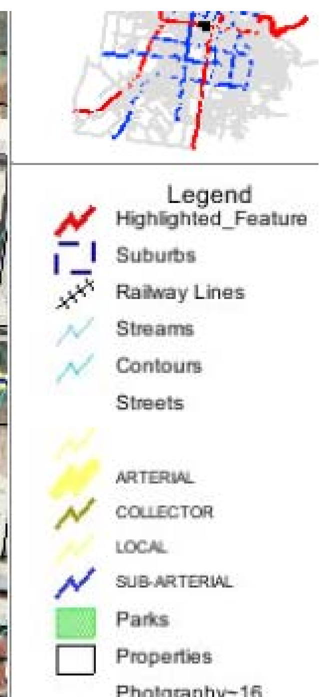
			Rank	15	**AA+**	
			Fault car dir.	Random		
Wet Crash-	0%		**Speed Limit**	60	km/h	
% of Cars -	94%	(or ute)	**Traffic Control**	signals		
% of Mtr Bke -	0%					

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
8/23/2001	Thursday	6am-6pm*	27,579	1.23	33,922	327

ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
8/02/2005	15:35	JAMES ST	WATER ST	0	0	21W
6/11/2001	12:40	JAMES ST	WATER ST	0	0	21W
6/08/2001	10:30	JAMES ST	WATER ST	0	0	35E
5/02/2004	14:20	JAMES ST	WATER ST	0	0	32W
4/06/2003	9:30	JAMES ST	WATER ST	0	0	21W
30/04/2002	14:00	JAMES ST	WATER ST	0	0	21W
29/12/2004	11:50	JAMES ST	WATER ST	0	0	21E
29/07/2003	9:30	JAMES ST	WATER ST	0	0	32W
27/03/2002	15:20	JAMES ST	WATER ST	0	0	31W
26/01/2002	10:44	JAMES ST	WATER ST	0	1	21W
25/09/2005	8:10	JAMES ST	WATER ST	0	1	00W
24/03/2005	10:10	JAMES ST	WATER ST	0	0	21W
23/11/2004	8:40	JAMES ST	WATER ST	0	0	21W
23/07/2002	16:20	JAMES ST	WATER ST	0	0	32W
21/12/2001	10:15	JAMES ST	WATER ST	0	2	21W
21/01/2005	11:45	JAMES ST	WATER ST	0	0	30W
15/02/2001	7:50	JAMES ST	WATER ST	0	1	21W
10/09/2004	14:10	JAMES ST	WATER ST	0	0	32W

NOTES:			**Rank**		16	**ALT**
			Fault car dir.	West		bound
Wet Crash-	11%		**Speed Limit**	60		km/h
% of Cars -	91%	(or ute)	**Traffic Control**	traffic signs		
% of Mtr Bke -	0%					

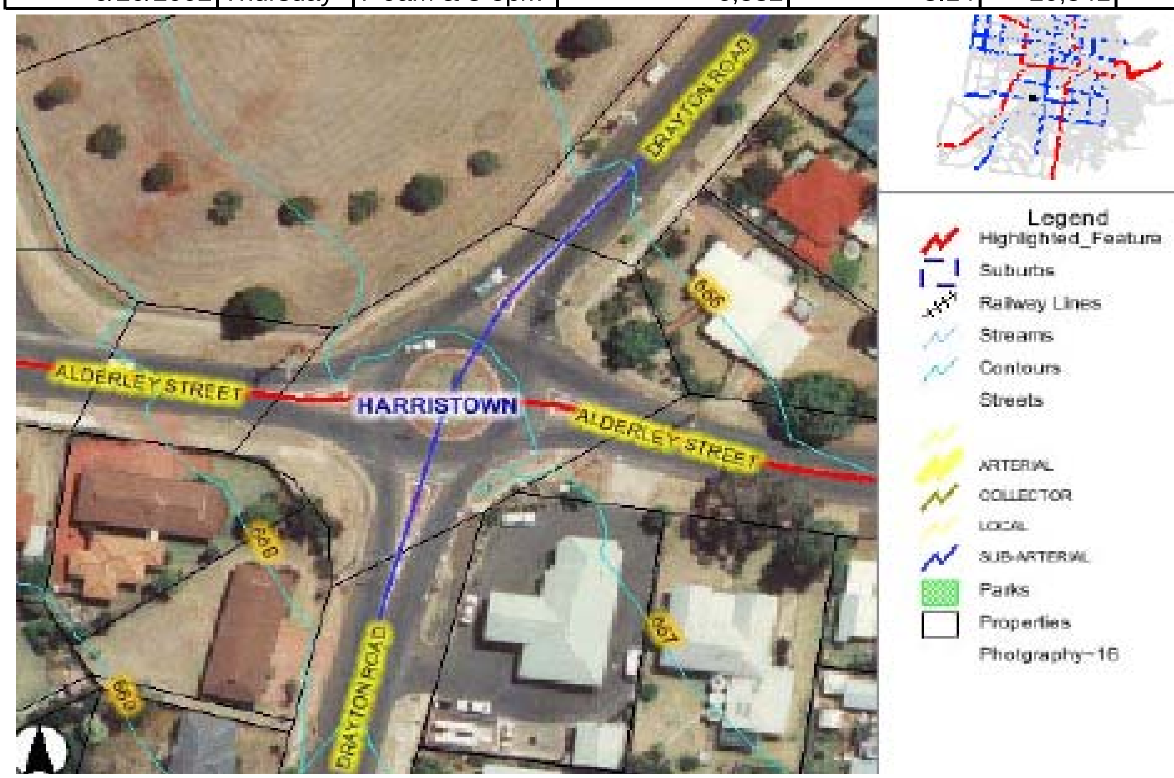
A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB	DAILY	ANNUAL
NIL						



ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
9/09/2003	7:15	ALDERLEY ST	DRAYTON RD	0	0	10N
6/12/2003	22:40	ALDERLEY ST	DRAYTON RD	0	0	71W
4/12/2003	9:15	ALDERLEY ST	DRAYTON RD	0	0	10S
4/07/2001	20:20	ALDERLEY ST	DRAYTON RD	0	0	10N
28/01/2003	17:10	ALDERLEY ST	DRAYTON RD	0	0	30S
26/06/2002	17:15	ALDERLEY ST	DRAYTON RD	0	0	10N
26/01/2004	0:10	ALDERLEY ST	DRAYTON RD	0	0	10N
24/04/2003	7:20	ALDERLEY ST	DRAYTON RD	0	0	10N
23/12/2002	21:45	ALDERLEY ST	DRAYTON RD	0	1	10N
2/03/2005	8:10	ALDERLEY ST	DRAYTON RD	0	1	30N
18/11/2003	19:34	ALDERLEY ST	DRAYTON RD	0	0	10N
16/07/2002	16:00	ALDERLEY ST	DRAYTON RD	0	0	10W
13/06/2003	11:40	ALDERLEY ST	DRAYTON RD	0	1	71N

NOTES:			**Rank**	25	**TSO**	
			Fault car dir.	North	bound	
Wet Crash-	0%		**Speed Limit**	60	km/h	
% of Cars -	88%	(or ute)	**Traffic Control**	Give way sign		9
% of Mtr Bke -	6%					

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
6/20/2002	Thursday	7-9am & 3-5pm	6,532	3.14	20,541	327



Source: TCC ATLIS (Website)

ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
24/05/2002	7:40	HURSLEY RD	McDOUGALL ST	0	1	10E
18/04/2002	9:00	HURSLEY RD	McDOUGALL ST	0	0	10S
14/03/2002	19:45	HURSLEY RD	McDOUGALL ST	0	0	10S

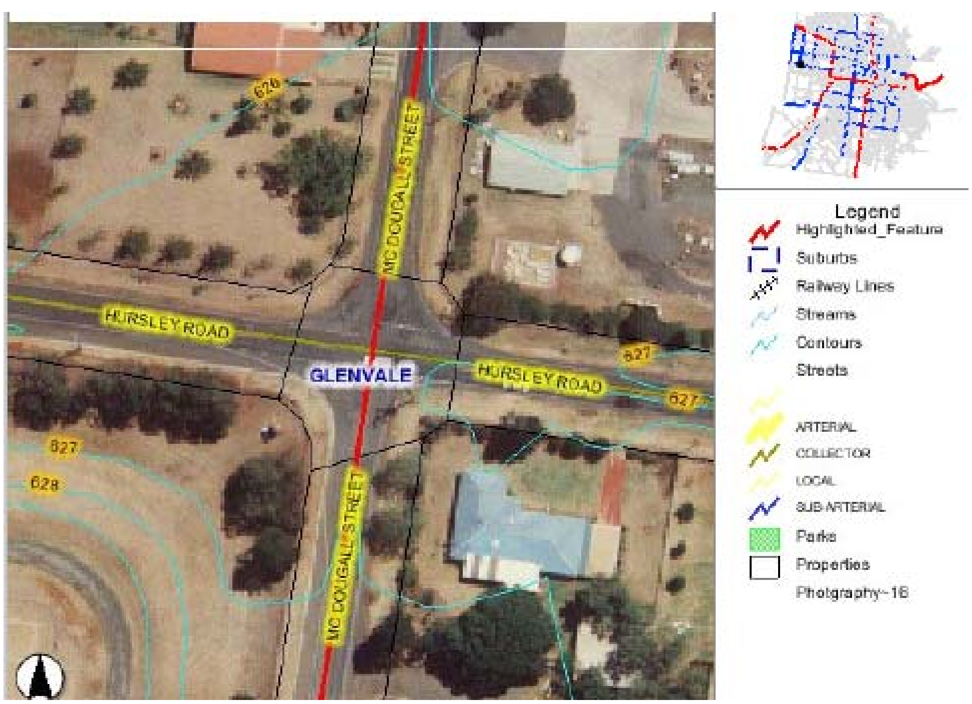
Rank 26 **SSO**

COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
11/5/1998	Thursday	7am-6pm	7,669	1.27	9,720	327

Crashes all in 2002 within a few months ???

Removed from Study

NOTES:
Dates- In 2002
Wet- NO
Cars only- YES
Direction -

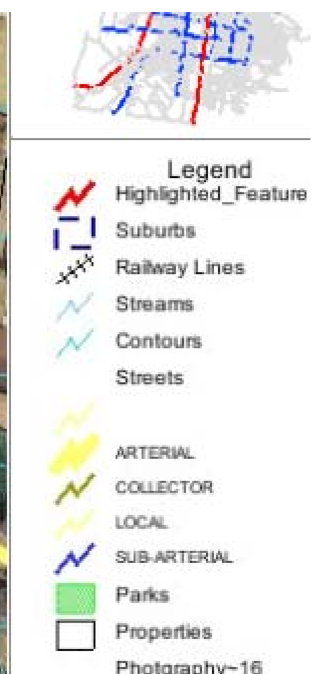


Source: TCC ATLIS (Website)

ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
9/06/2003	15:30	BRIDGE ST	McGREGOR ST	0	0	30E
8/02/2001	17:00	BRIDGE ST	McGREGOR ST	0	0	21W
6/09/2001	15:00	BRIDGE ST	McGREGOR ST	0	0	30W
27/06/2003	20:05	BRIDGE ST	McGREGOR ST	0	1	30E
25/05/2004	17:10	BRIDGE ST	McGREGOR ST	0	2	40W
23/05/2003	19:45	BRIDGE ST	McGREGOR ST	0	0	21E
21/02/2001	13:00	BRIDGE ST	McGREGOR ST	0	0	34W
19/11/2002	17:15	BRIDGE ST	McGREGOR ST	0	0	30E
17/07/2002	16:38	BRIDGE ST	McGREGOR ST	0	0	31N
11/09/2004	16:15	BRIDGE ST	McGREGOR ST	0	0	30W

NOTES:			**Rank**		28	**ATT**
			Fault car dir.		E & W	bound
Wet Crash-	0%		**Speed Limit**		60	km/h
% of Cars -	93%	(or ute)	**Traffic Control**	signals		
% of Mtr Bke -	0%					

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
6/18/1998	Thursday	6am-6pm	21,505	1.20	25,806	327



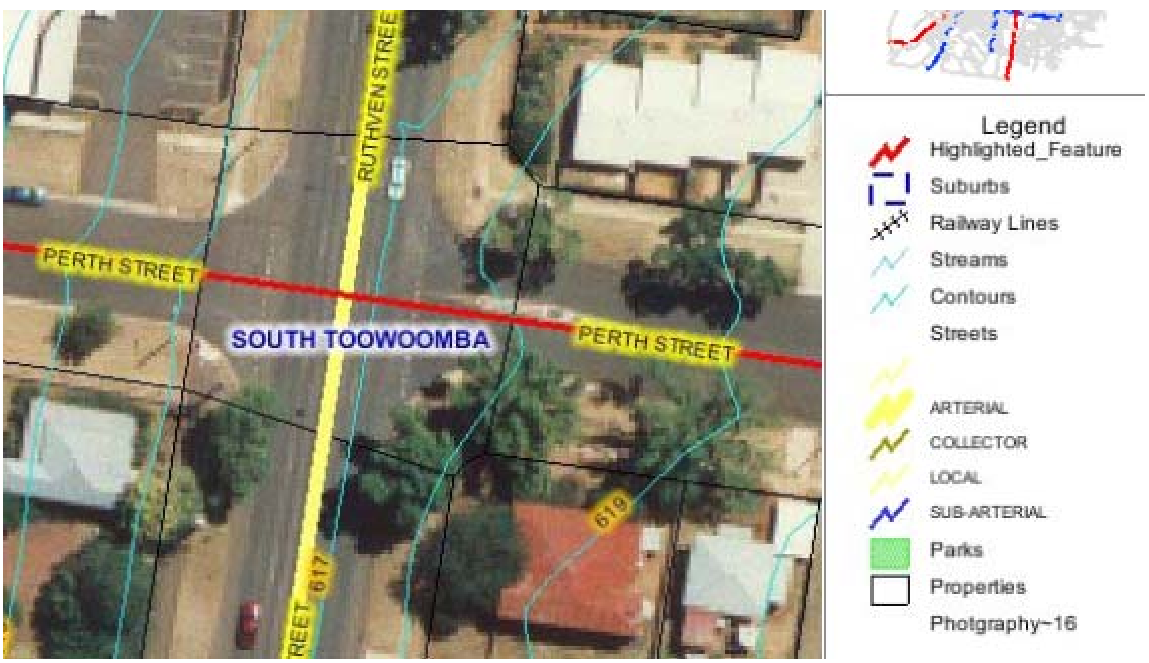
ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
6/12/2002	12:10	PERTH ST	RUTHVEN ST	0	0	31N
6/09/2001	15:15	PERTH ST	RUTHVEN ST	0	0	10W
4/09/2002	16:00	PERTH ST	RUTHVEN ST	0	0	21W
31/05/2003	10:55	PERTH ST	RUTHVEN ST	0	0	21N
28/07/2003	16:28	PERTH ST	RUTHVEN ST	0	0	32N
24/07/2003	15:15	PERTH ST	RUTHVEN ST	0	0	32N
24/04/2001	13:47	PERTH ST	RUTHVEN ST	0	0	31N
20/05/2005	17:45	PERTH ST	RUTHVEN ST	0	0	30S
19/05/2005	17:35	PERTH ST	RUTHVEN ST	0	0	21N
17/02/2004	16:00	PERTH ST	RUTHVEN ST	0	0	32S
16/09/2002	10:50	PERTH ST	RUTHVEN ST	0	0	21S
10/12/2002	11:15	PERTH ST	RUTHVEN ST	0	1	32S
10/02/2005	10:20	PERTH ST	RUTHVEN ST	0	0	21N

NOTES:

Wet Crash- 0%
% of Cars - 94%
% of Mtr Bke - 0%

Rank 33 **LA+**
Fault car dir. Random
Speed Limit 60 km/h
Traffic Control traffic signs

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
4/2/1998	Thursday	6am-6pm	16,213	1.20	19,456	327



Source: TCC ATLIS (Website)

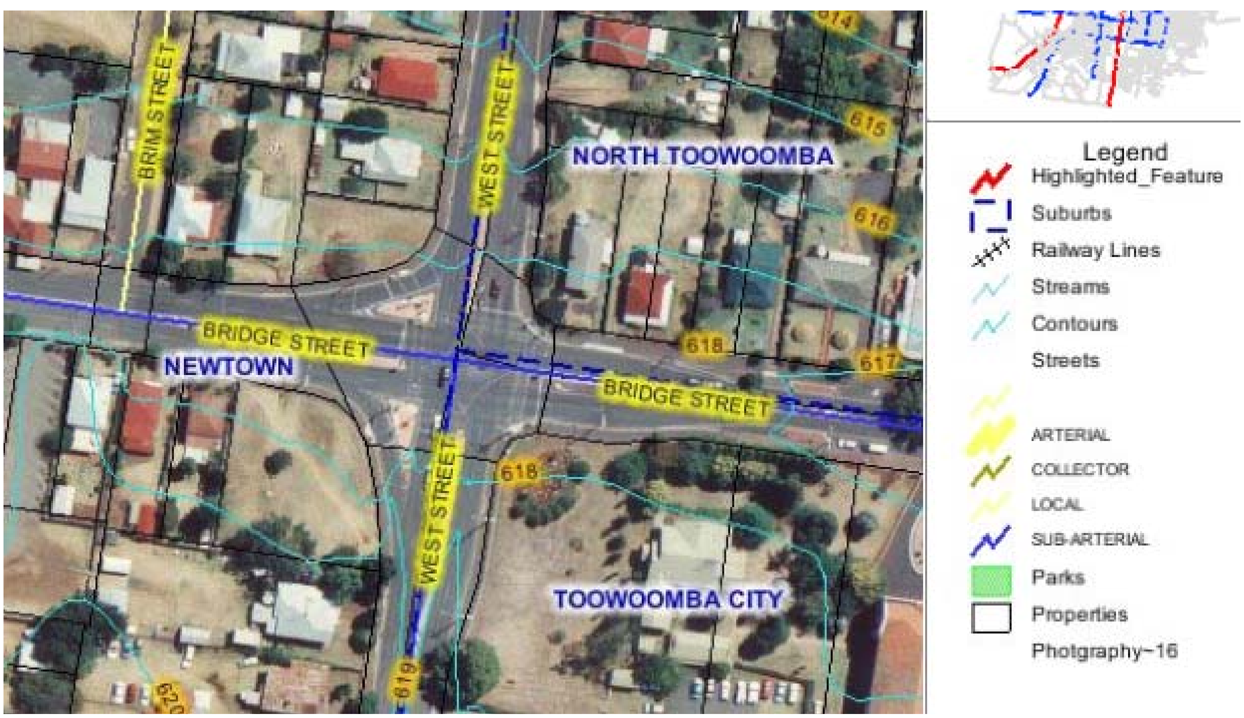
ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
9/01/2003	20:15	BRIDGE ST	WEST ST	0	2	10S
7/09/2003	12:05	BRIDGE ST	WEST ST	0	0	10N
5/09/2001	9:30	BRIDGE ST	WEST ST	0	0	21N
5/04/2002	8:40	BRIDGE ST	WEST ST	0	0	21E
26/08/2001	0:05	BRIDGE ST	WEST ST	0	0	81E
25/12/2002	10:40	BRIDGE ST	WEST ST	0	1	81E
21/04/2004	10:25	BRIDGE ST	WEST ST	0	1	10N
20/06/2005	18:20	BRIDGE ST	WEST ST	0	0	21S
19/03/2005	9:40	BRIDGE ST	WEST ST	0	0	30E
16/04/2003	7:40	BRIDGE ST	WEST ST	0	0	10E
15/10/2004	9:15	BRIDGE ST	WEST ST	0	0	12N
13/09/2003	7:30	BRIDGE ST	WEST ST	0	0	87E
13/05/2005	10:50	BRIDGE ST	WEST ST	0	0	31N
11/03/2002	21:15	BRIDGE ST	WEST ST	0	0	85N

NOTES:

Wet Crash- 0%
% of Cars - 100%
% of Mtr Bke - 0%

Rank 35 **SS+**
Fault car dir. Random
Speed Limit 60 km/h
Traffic Control signals

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
2/14/1997	Friday	8-10.30&1.30-6	13,490	1.85	24,981	321



Source: TCC ATLIS (Website)

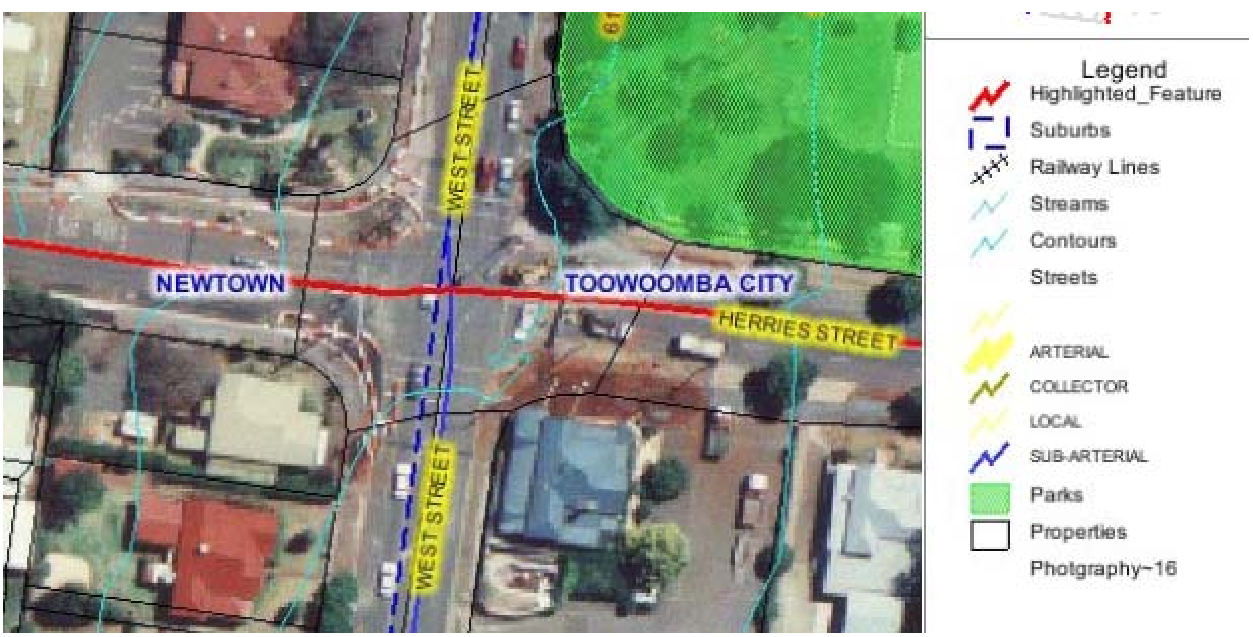
ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
7/08/2001	15:30	HERRIES ST	WEST ST	0	0	21E
4/09/2004	11:30	HERRIES ST	WEST ST	0	0	10N
4/03/2004	7:00	HERRIES ST	WEST ST	0	0	66N
4/01/2002	10:30	HERRIES ST	WEST ST	0	0	21N
26/07/2002	13:45	HERRIES ST	WEST ST	0	0	21N
24/10/2005	9:40	HERRIES ST	WEST ST	0	0	23N
19/02/2002	11:00	HERRIES ST	WEST ST	0	1	10N
15/01/2002	17:48	HERRIES ST	WEST ST	0	1	00S
11/06/2003	15:30	HERRIES ST	WEST ST	0	0	21N

NOTES:

Wet Crash- 0%
% of Cars - 80%
% of Mtr Bke - 0%

Rank 44 **SS+**
Fault car dir. North bound
Speed Limit 60 km/h
Traffic Control signals

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
4/30/1998	Thursday	7am-6pm	24,240	1.27	30,722	327



Source: TCC ATLIS (Website)

ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
8/12/2004	7:40	BRIDGE ST	GREENWATTLE ST	0	0	31S
4/05/2001	18:00	BRIDGE ST	GREENWATTLE ST	0	0	32S
31/12/2002	17:25	BRIDGE ST	GREENWATTLE ST	0	0	13S
21/07/2001	19:00	BRIDGE ST	GREENWATTLE ST	0	1	13S
19/04/2001	19:30	BRIDGE ST	GREENWATTLE ST	0	1	11S
12/03/2001	7:55	BRIDGE ST	GREENWATTLE ST	0	0	13S

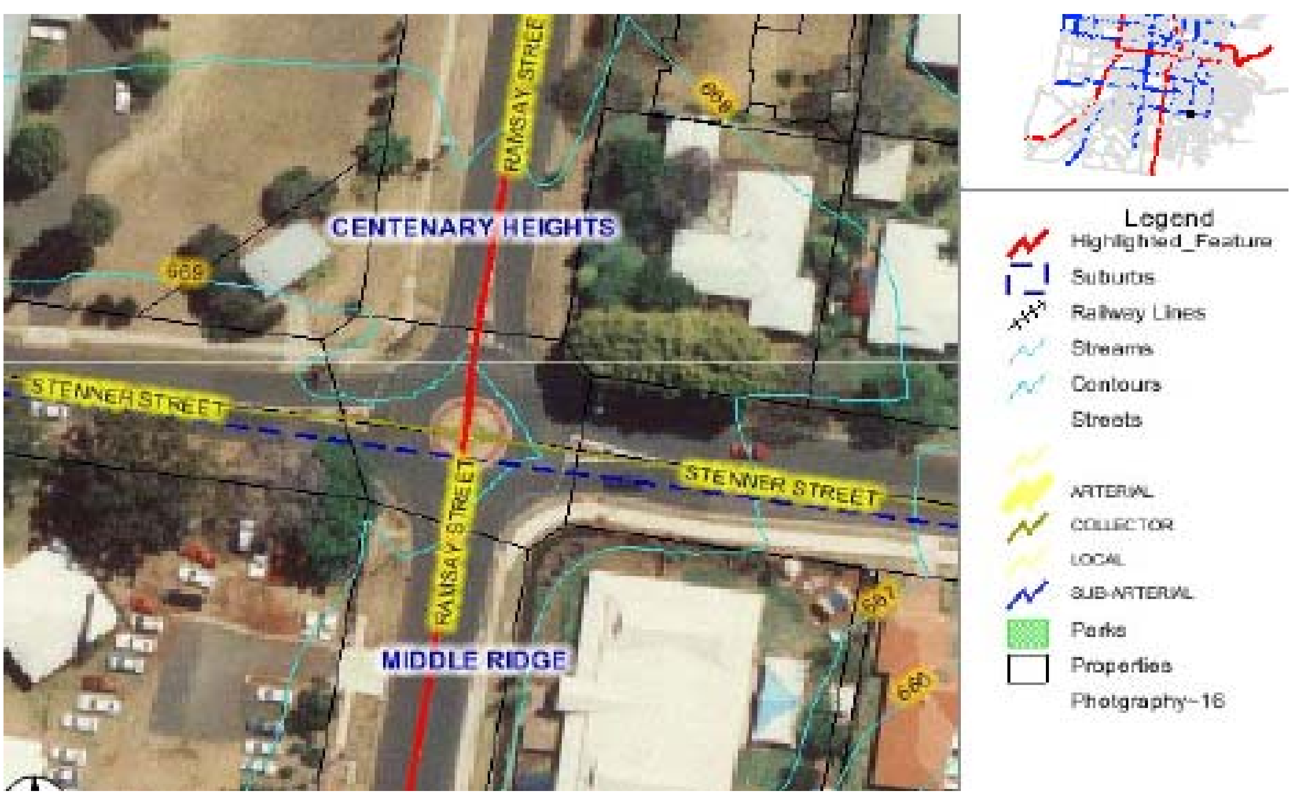
NOTES:			**Rank**	47	**ATT**
			Fault car dir.	South	bound
Wet Crash-	0%		**Speed Limit**	60	km/h
% of Cars -	100%	(or ute)	**Traffic Control**	traffic signs	
% of Mtr Bke -	0%				

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
4/22/1999	Thursday	8-9am & 2-4pm	4,539	4.17	18,913	327

ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
9/10/2001	8:15	RAMSAY ST	STENNER ST	0	0	30W
6/09/2001	5:15	RAMSAY ST	STENNER ST	0	0	10E
5/05/2005	22:25	RAMSAY ST	STENNER ST	0	0	10E
5/02/2004	14:30	RAMSAY ST	STENNER ST	0	0	10E
4/12/2003	22:15	RAMSAY ST	STENNER ST	0	0	10N
4/07/2003	20:45	RAMSAY ST	STENNER ST	0	0	30S
4/01/2002	16:27	RAMSAY ST	STENNER ST	0	0	10S
28/08/2003	9:05	RAMSAY ST	STENNER ST	0	0	10S
13/05/2002	6:15	RAMSAY ST	STENNER ST	0	0	10E
13/03/2003	1:10	RAMSAY ST	STENNER ST	0	1	10E

NOTES:			**Rank**	52	**TTO**
			Fault car dir.	Random	
Wet Crash-	0%		**Speed Limit**	60	km/h
% of Cars -	86%	(or ute)	**Traffic Control**	Give way sign	9
% of Mtr Bke -	7%				

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
8/5/2004	Thursday	6am-6pm	12,315	1.23	15,092	327



ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
5/09/2005	8:45	HUME ST	STENNER ST	0	0	30S
30/07/2001	15:15	HUME ST	STENNER ST	0	0	30W
25/01/2003	20:35	HUME ST	STENNER ST	0	0	64N
20/08/2003	15:15	HUME ST	STENNER ST	0	0	30W
18/11/2003	14:15	HUME ST	STENNER ST	0	0	71N

NOTES:

Rank 61 **SSO**

Fault car dir. Random

Wet Crash- 0%

Speed Limit 60 km/h

% of Cars - 91% (or ute)

Traffic Control Give way sign 9

% of Mtr Bke - 9%

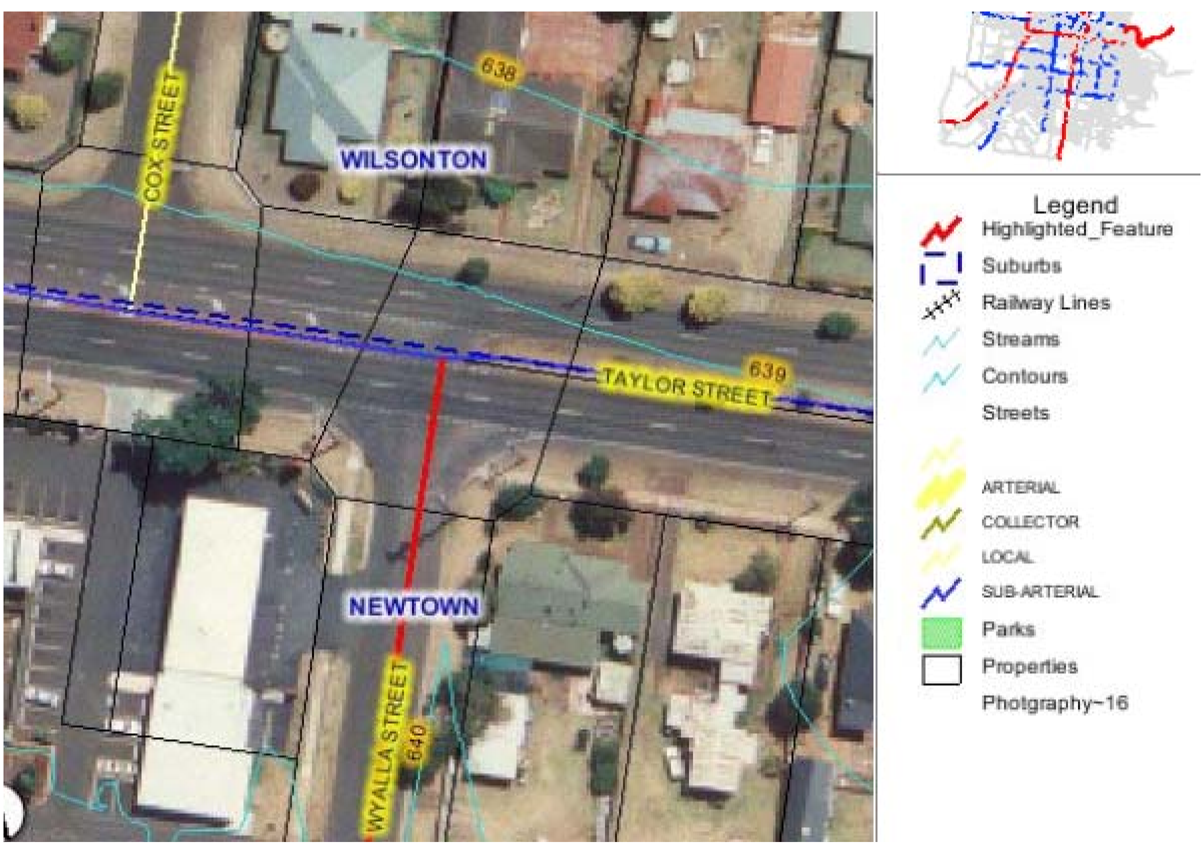
A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
3/15/2002	Friday	7am-6pm	15,140	1.27	19,189	321

ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
8/09/2003	11:00	TAYLOR ST	WYALLA ST	0	1	11N
8/07/2002	14:45	TAYLOR ST	WYALLA ST	0	0	13N
6/02/2004	18:00	TAYLOR ST	WYALLA ST	0	0	13N
31/01/2001	10:15	TAYLOR ST	WYALLA ST	0	0	13N
29/11/2001	16:50	TAYLOR ST	WYALLA ST	0	0	13N
24/10/2001	12:25	TAYLOR ST	WYALLA ST	0	0	64W
2/12/2004	11:40	TAYLOR ST	WYALLA ST	0	3	13N

NOTES:

Wet Crash-	0%		**Rank**	65	**LST**
% of Cars -	100%	(or ute)	**Fault car dir.**	North	bound
% of Mtr Bke -	0%		**Speed Limit**	60	km/h
			Traffic Control	No traffic control	

A - 24 COUNT	DAY	DURATION	COUNT VOLUME	AADT CALIB	DAILY	ANNUAL
6/6/2002	Thursday	7-9am & 3-5pm	4,871	3.14	15,318	327



ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
7/06/2001	8:14	JAMES ST	MACKENZIE ST	0	0	98-
31/03/2004	7:25	JAMES ST	MACKENZIE ST	0	0	10S
3/12/2003	8:45	JAMES ST	MACKENZIE ST	0	0	30W
3/05/2002	8:20	JAMES ST	MACKENZIE ST	0	0	35E
29/04/2005	14:10	JAMES ST	MACKENZIE ST	0	1	30W
27/08/2004	0:15	JAMES ST	MACKENZIE ST	0	0	73E
24/09/2001	8:30	JAMES ST	MACKENZIE ST	0	0	91W
23/02/2002	10:30	JAMES ST	MACKENZIE ST	0	0	10N
23/02/2002	10:30	JAMES ST	MACKENZIE ST	0	0	10N

NOTES:		**Rank**	79	**AL+**
		Fault car dir.	Random	
Wet Crash-	14%	**Speed Limit**	60	km/h
% of Cars -	89%	**Traffic Control**	signals	
% of Mtr Bke -	0%			

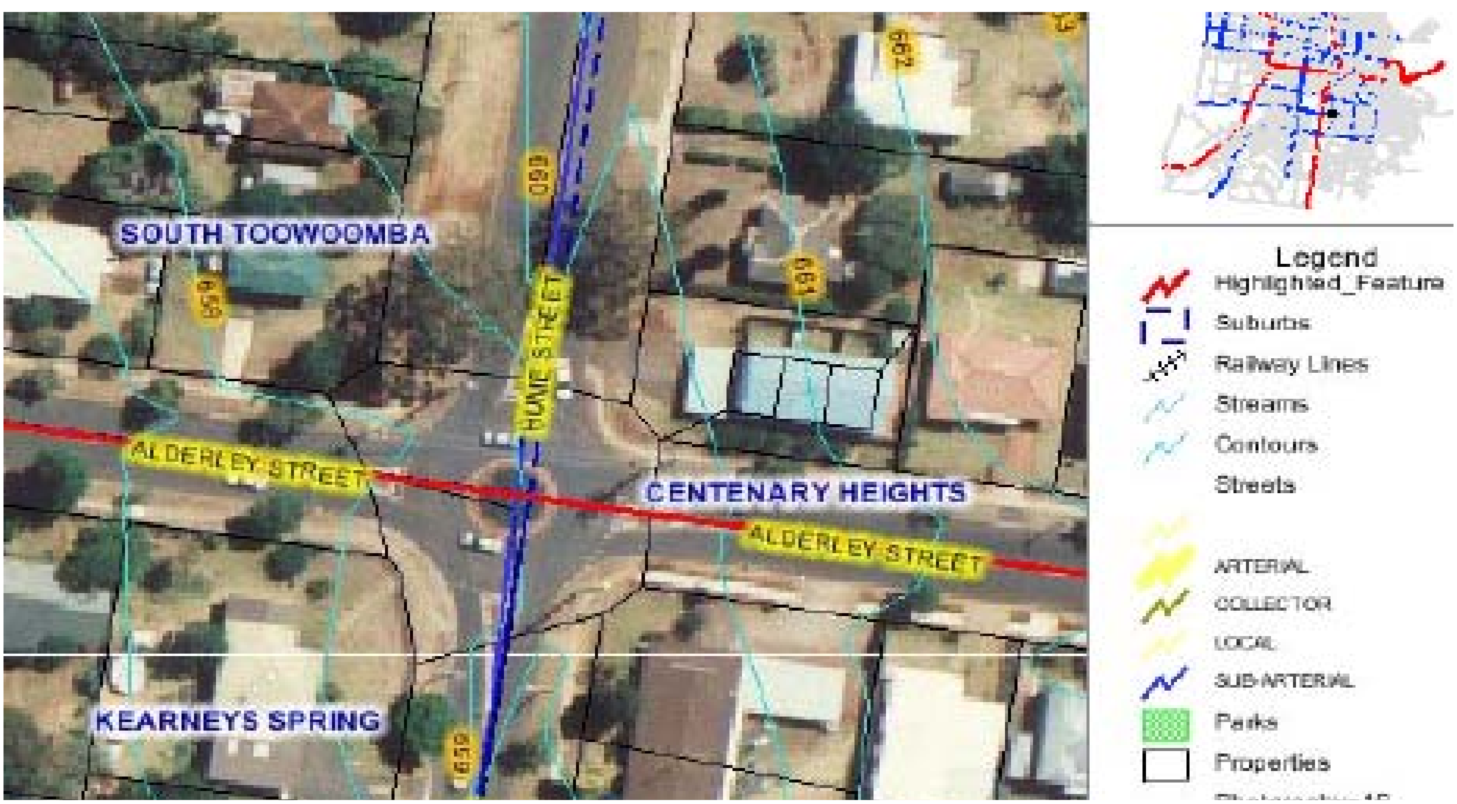
A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
8/6/2003	Wednesda	6am-6pm*	14,005	1.23	17,226	349

Source: TCC ATLIS (Website)

ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
6/2/2004	6:45	ALDERLEY ST	HUME ST	0	0	10W
5/08/2003	17:20	ALDERLEY ST	HUME ST	0	0	30S
29/07/2005	17:50	ALDERLEY ST	HUME ST	0	0	30E
28/07/2005	7:55	ALDERLEY ST	HUME ST	0	0	21N
26/01/2004	19:00	ALDERLEY ST	HUME ST	0	0	71W
20/02/2004	18:41	ALDERLEY ST	HUME ST	0	0	30E
2/12/2004	16:00	ALDERLEY ST	HUME ST	0	1	30E
17/03/2005	17:00	ALDERLEY ST	HUME ST	0	1	30S
13/08/2003	19:45	ALDERLEY ST	HUME ST	0	1	10E
12/11/2003	18:10	ALDERLEY ST	HUME ST	0	1	30E
12/08/2002	12:45	ALDERLEY ST	HUME ST	0	1	10N
1/06/2005	13:10	ALDERLEY ST	HUME ST	0	0	85W

NOTES:			**Rank**	80	**TSO**
			Fault car dir.	Random	
Wet Crash-	0%		**Speed Limit**	60	km/h
% of Cars -	100%	(or ute)	**Traffic Control**	Give way sign	9
% of Mtr Bke -	0%				

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
11/5/1998	Thursday	8-9am & 2-4pm	4,214	4.17	17,558	327



ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
9/08/2004	12:12	NELSON ST	RUTHVEN ST	0	0	10W
30/09/2002	17:20	NELSON ST	RUTHVEN ST	0	0	21S
30/05/2005	7:51	NELSON ST	RUTHVEN ST	0	0	10S
2/10/2002	8:10	NELSON ST	RUTHVEN ST	0	1	10E
2/09/2004	7:58	NELSON ST	RUTHVEN ST	0	0	10N
15/01/2003	19:00	NELSON ST	RUTHVEN ST	0	0	21S
14/09/2005	16:45	NELSON ST	RUTHVEN ST	0	0	10W
12/06/2003	16:30	NELSON ST	RUTHVEN ST	0	0	10N

NOTES:			**Rank**	89	**LA+**
Wet Crash-	0%		**Fault car dir.**	Random	
% of Cars -	86%	(or ute)	**Speed Limit**	60	km/h
% of Mtr Bke -	7%		**Traffic Control**	traffic signs	

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
5/18/2000	Thursday	6am-6pm*	6,462	1.23	7,948	327

Source: TCC ATLIS (Website)

ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
8/07/2004	17:00	BRIDGE ST	RICHMOND DR	0	0	30W
4/07/2002	17:45	BRIDGE ST	RICHMOND DR	0	0	13S
27/09/2001	9:47	BRIDGE ST	RICHMOND DR	0	1	30W
26/04/2001	11:20	BRIDGE ST	RICHMOND DR	0	1	21W
19/07/2004	8:10	BRIDGE ST	RICHMOND DR	0	0	01W
18/02/2002	8:45	BRIDGE ST	RICHMOND DR	0	0	34E
15/02/2002	15:20	BRIDGE ST	RICHMOND DR	0	0	30E

NOTES:

			Rank		94	**ATT**
			Fault car dir.	Random		
Wet Crash-	0%		**Speed Limit**	60		km/h
% of Cars -	92%	(or ute)	**Traffic Control**	signals		
% of Mtr Bke -	0%					

A - 24 COUNT	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY	ANNUAL
8/29/2002	Thursday	6am-6pm*	15,265	1.23	18,776	327

Source: TCC ATLIS (Website)

ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
30/04/2003	16:20	GREENWATTLE ST	HURSLEY RD	0	0	10N
15/08/2005	14:15	GREENWATTLE ST	HURSLEY RD	0	1	10W
13/04/2004	14:30	GREENWATTLE ST	HURSLEY RD	0	0	10E
11/10/2001	17:40	GREENWATTLE ST	HURSLEY RD	0	1	90S
1/3/2003	4:30	GREENWATTLE ST	HURSLEY RD	0	0	30W

NOTES:

			Rank	98	**TTO**	
			Fault car dir.	Random		
Wet Crash-	33%		**Speed Limit**	60	km/h	
% of Cars -	80%	(or ute)	**Traffic Control**	Give way sign		9
% of Mtr Bke -	20%					

A - 24 COUNT DATE	DAY	DURATION	COUNT VOLUME	AADT CALIB FACTOR	DAILY VOL	ANNUAL CALIB F
3/25/1999	Thursday	8-9am & 2-4pm	3,073	4.17	12,804	327

ACCDATE	ACCTIME	MAJSTR	MINSTR	KILLED	INJURY	RUMDIR
4/11/2001	12:40	O'QUINN ST	WEST ST	0	1	21S
4/06/2001	15:30	O'QUINN ST	WEST ST	0	0	30N
21/10/2004	15:30	O'QUINN ST	WEST ST	0	1	13E
17/07/2002	15:15	O'QUINN ST	WEST ST	0	2	32S
14/03/2005	11:40	O'QUINN ST	WEST ST	0	1	13E
14/03/2005	11:40	O'QUINN ST	WEST ST	0	1	13E
13/09/2002	15:30	O'QUINN ST	WEST ST	0	0	13E

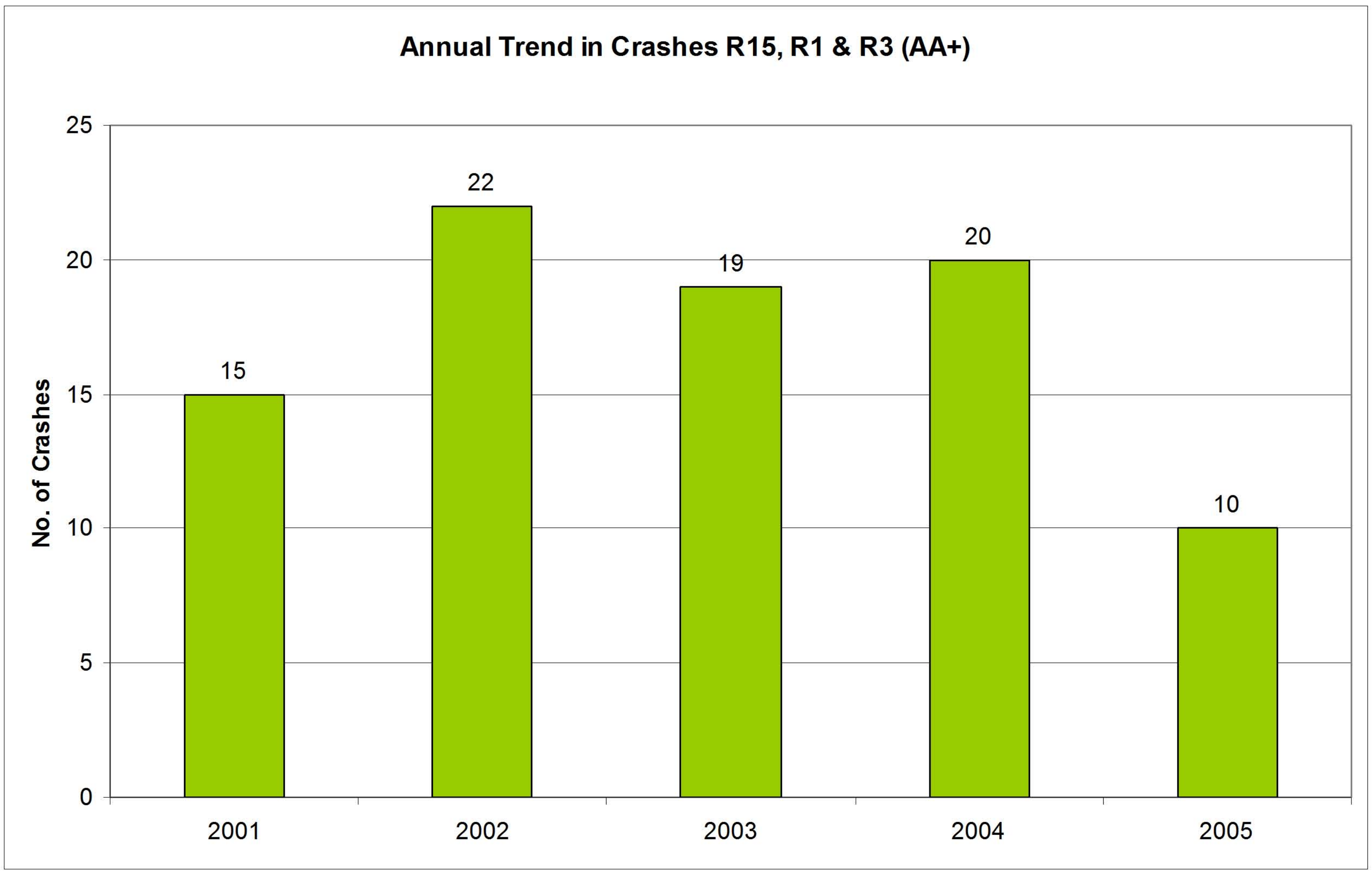
NOTES:			**Rank**	100	**LST**
			Fault car dir.	S & E	bound
Wet Crash-	0%	(or ute)	**Speed Limit**	60	km/h
% of Cars -	100%		**Traffic Control**	no contol	
% of Mtr Bke -	0%				

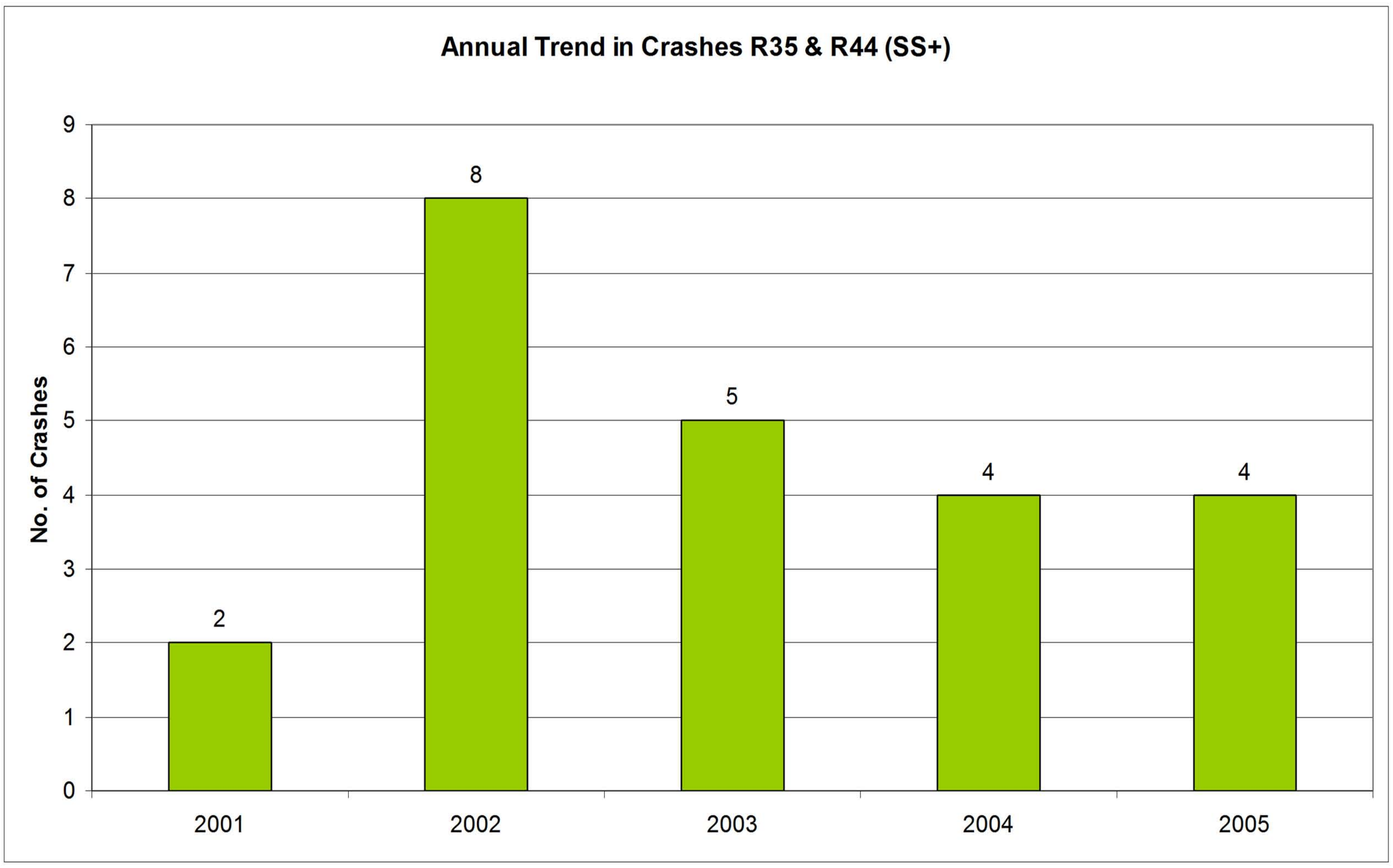
A - 24 COUNT	DAY	DURATION	COUNT VOLUME	AADT CALIB	DAILY	ANNUAL
NIL						

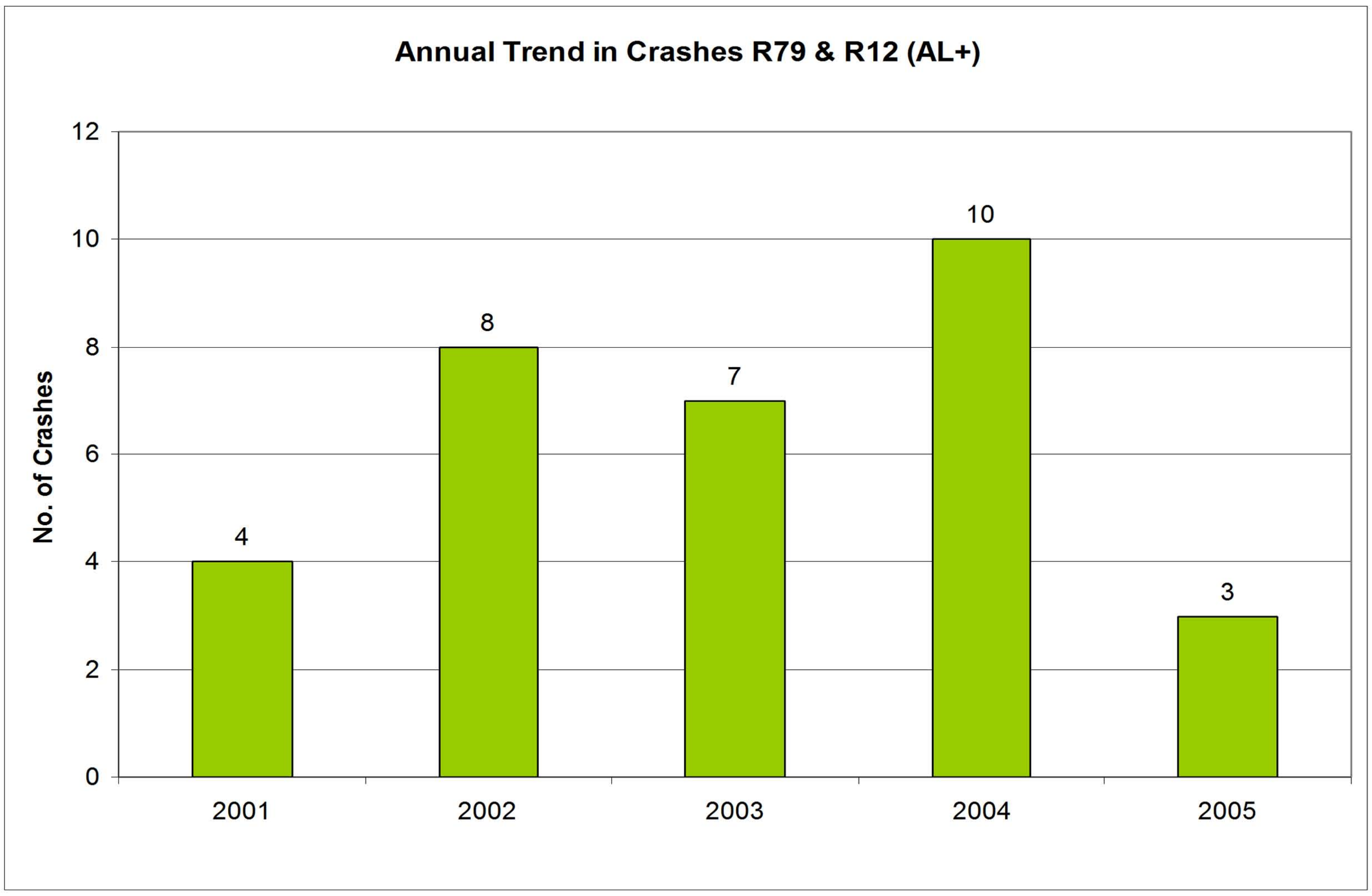
Source: TCC ATLIS (Website)

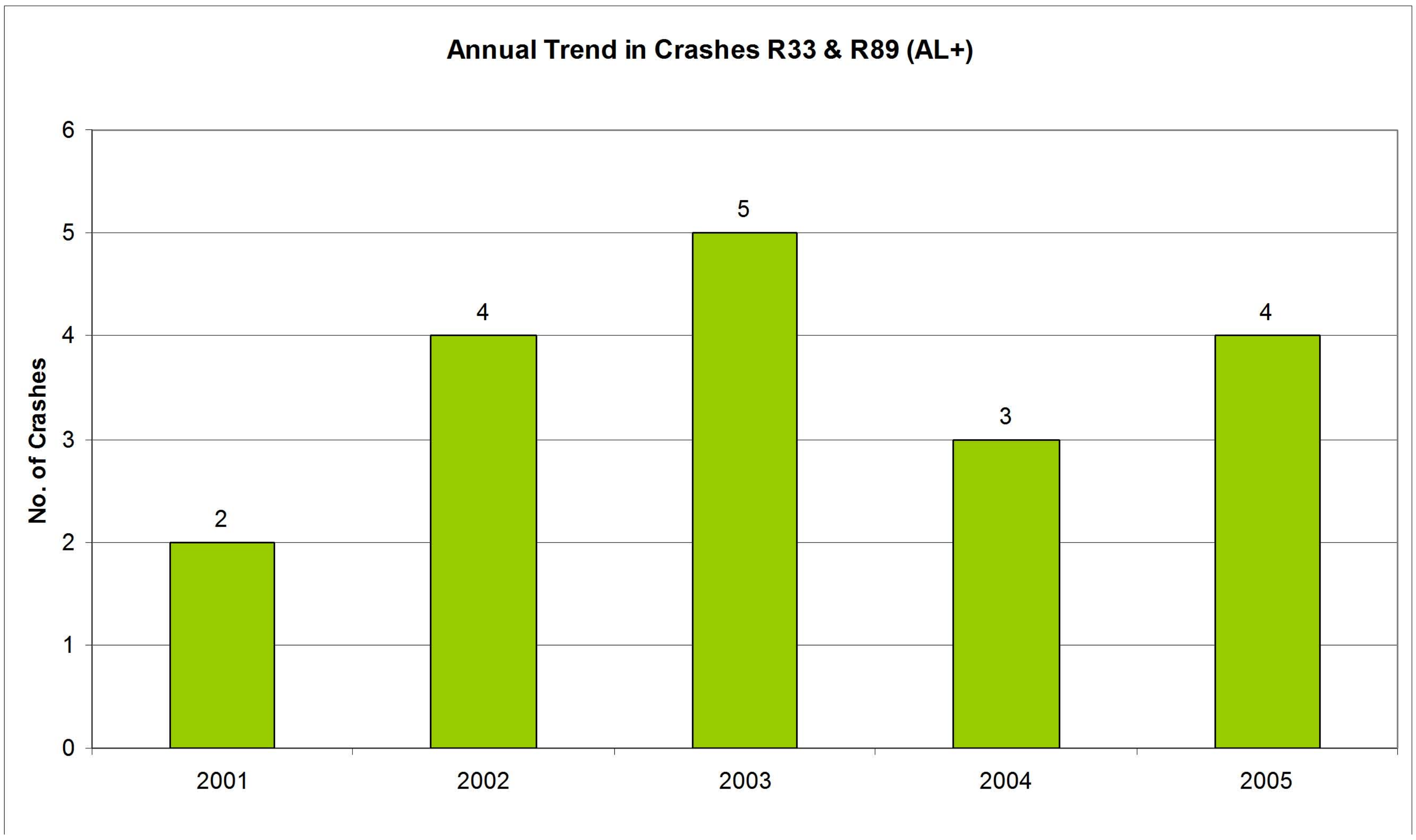
Appendix H – Annual Crash Trends by Intersection Type Graphs

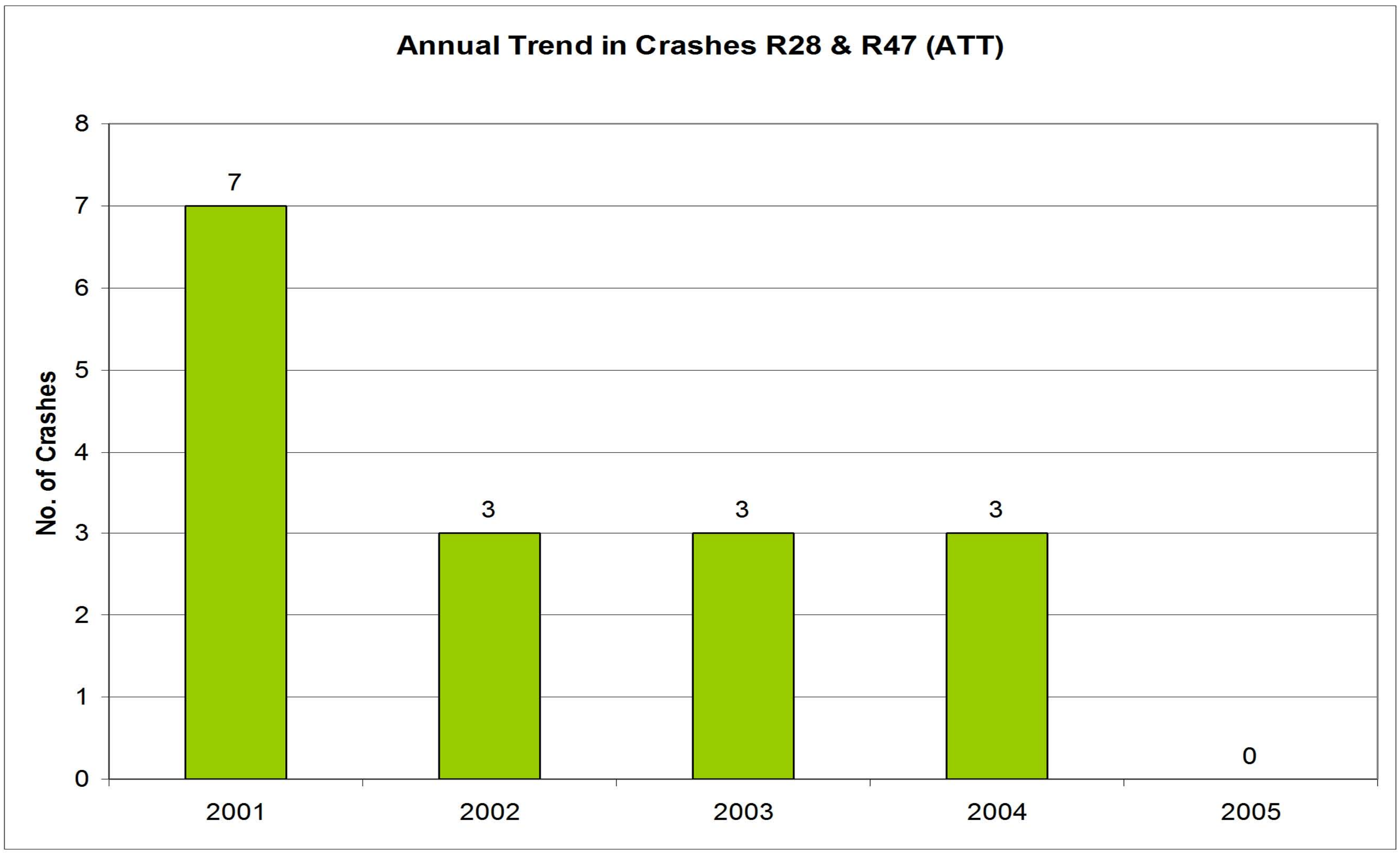
H

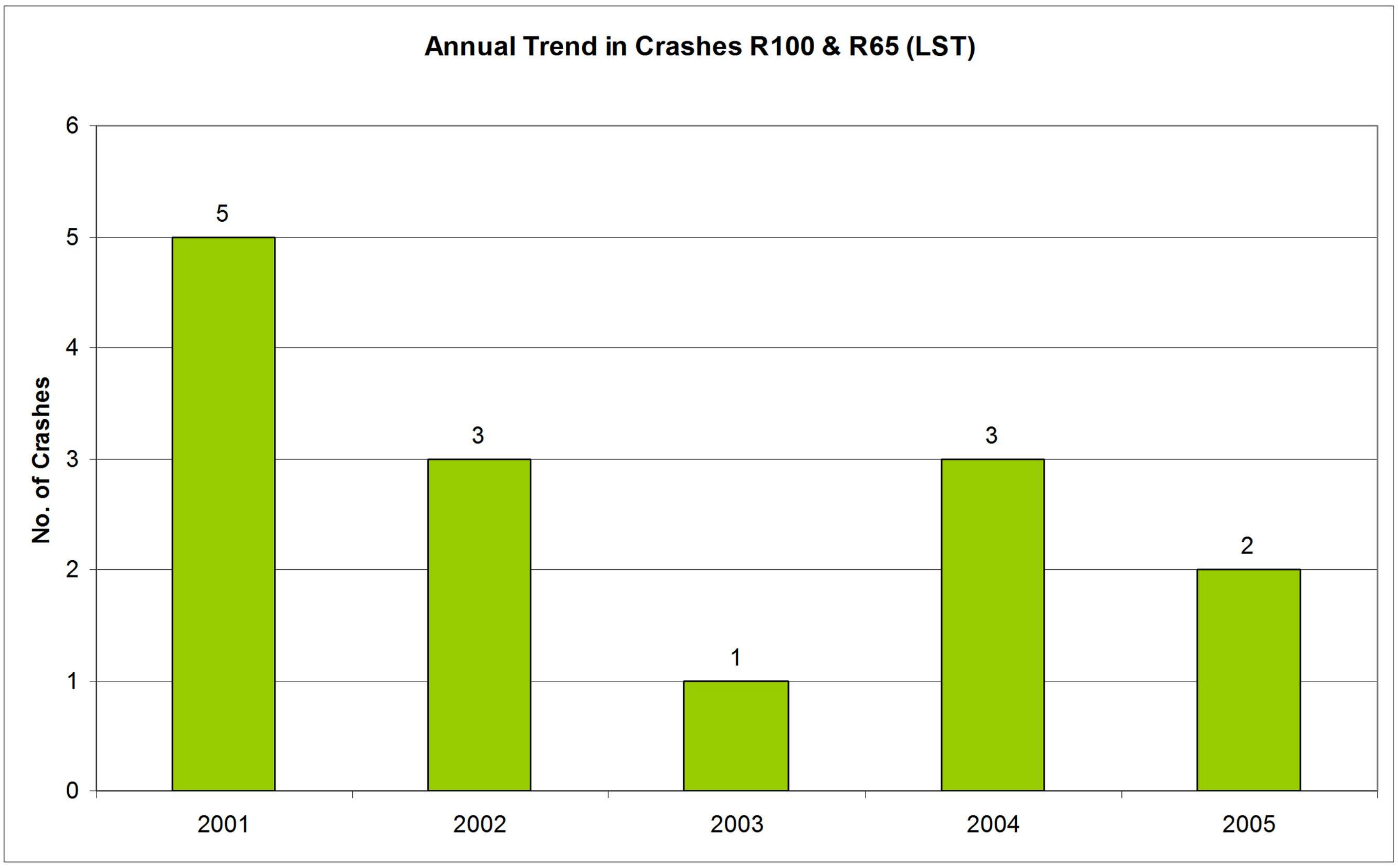

Annual Trend in Crashes R15, R1 & R3 (AA+)
No. of Crashes
0
5
10
15
20
25
15
22
19
20
10
2001
2002
2003
2004
2005

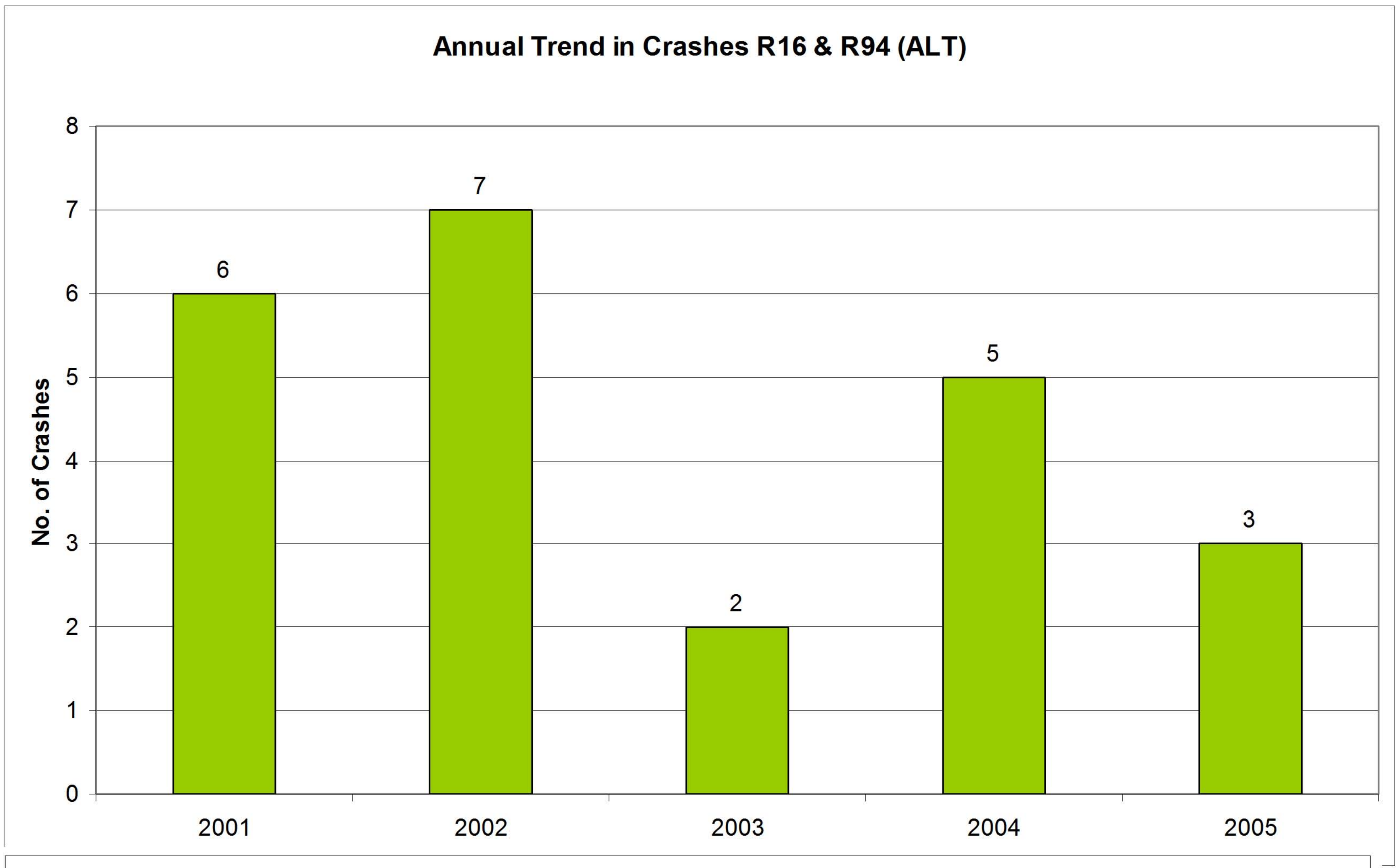

Annual Trend in Crashes R35 & R44 (SS+)
No. of Crashes
0
1
2
3
4
5
6
7
8
9
2
8
5
4
4
2001
2002
2003
2004
2005


Annual Trend in Crashes R79 & R12 (AL+)
No. of Crashes
0
2
4
6
8
10
12
4
8
7
10
3
2001
2002
2003
2004
2005

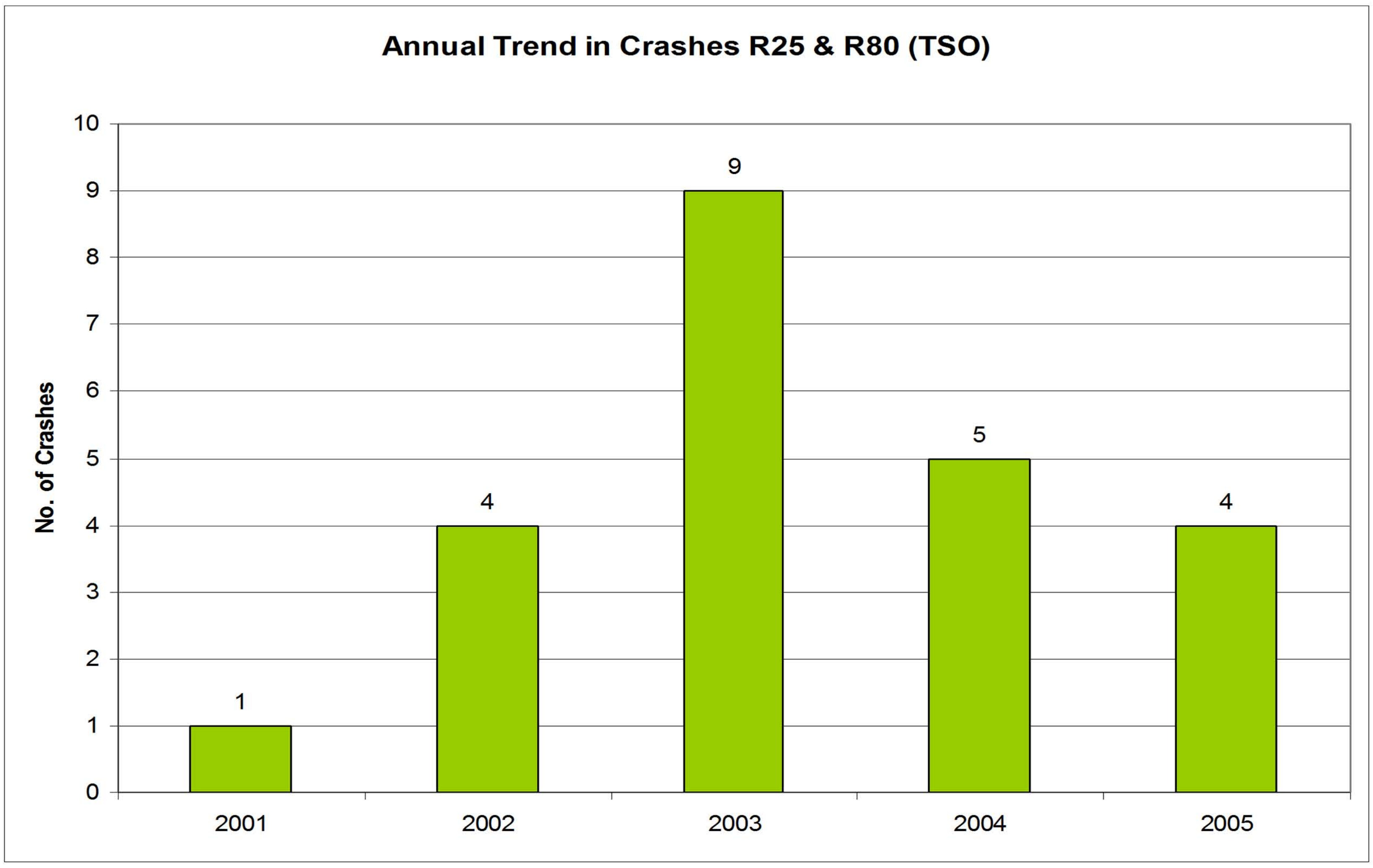

Annual Trend in Crashes R33 & R89 (AL+)
No. of Crashes
0
1
2
3
4
5
6
2
4
5
3
4
2001
2002
2003
2004
2005


Annual Trend in Crashes R28 & R47 (ATT)
No. of Crashes
0
1
2
3
4
5
6
7
8
7
3
3
3
0
2001
2002
2003
2004
2005

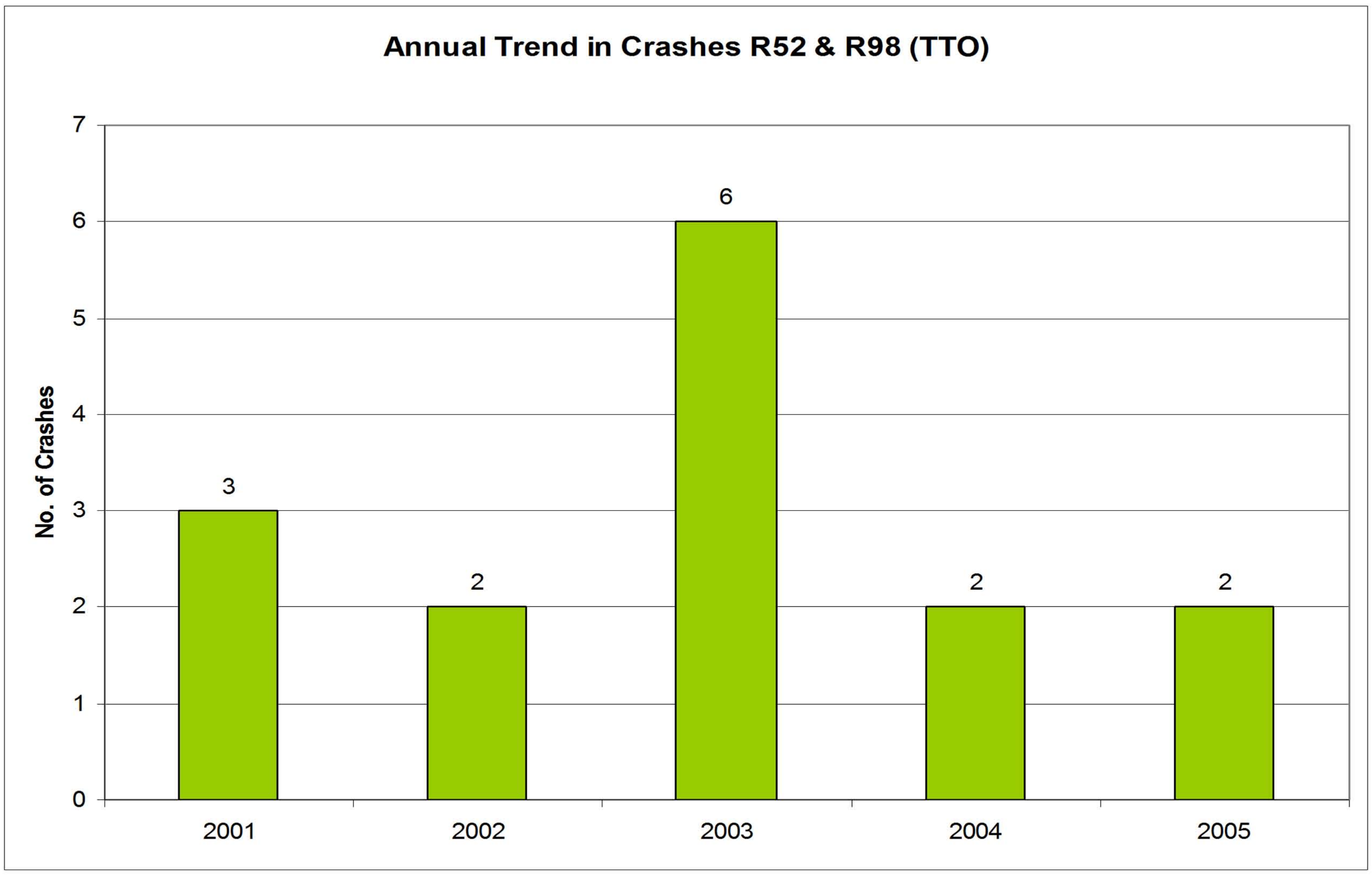

Annual Trend in Crashes R100 & R65 (LST)
No. of Crashes
0
1
2
3
4
5
6
5
3
1
3
2
2001
2002
2003
2004
2005



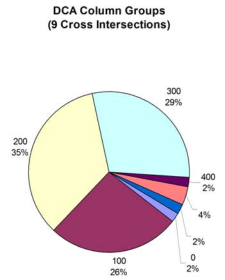
Annual Trend in Crashes R16 & R94 (ALT)
No. of Crashes
0
1
2
3
4
5
6
7
8
6
7
2
5
3
2001
2002
2003
2004
2005



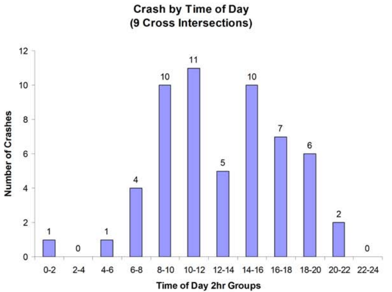
Annual Trend in Crashes R25 & R80 (TSO)
No. of Crashes
0
1
2
3
4
5
6
7
8
9
10
1
4
9
5
4
2001
2002
2003
2004
2005



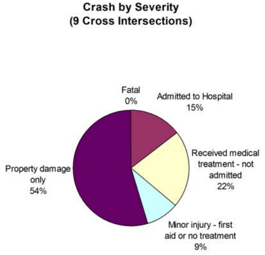
Annual Trend in Crashes R52 & R98 (TTO)
No. of Crashes
0
1
2
3
4
5
6
7
3
2
6
2
2
2001
2002
2003
2004
2005



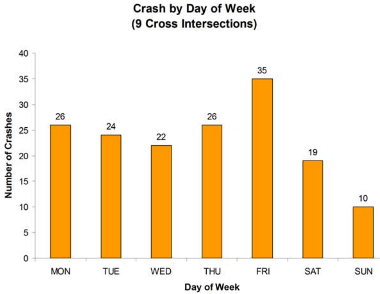
DCA Column Groups
(9 Cross Intersections)
300
29%
200
35%
400
2%
4%
2%
0
2%
100
26%



Crash by Time of Day
(9 Cross Intersections)
Number of Crashes
Time of Day 2hr Groups
0-2
2-4
4-6
6-8
8-10
10-12
12-14
14-16
16-18
18-20
20-22
22-24
1
0
1
4
10
11
5
10
7
6
2
0

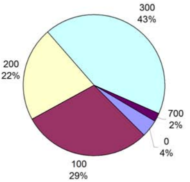


Crash by Severity
(9 Cross Intersections)
Fatal
0%
Admitted to Hospital
15%
Received medical treatment - not admitted
22%
Minor injury - first aid or no treatment
9%
Property damage only
54%

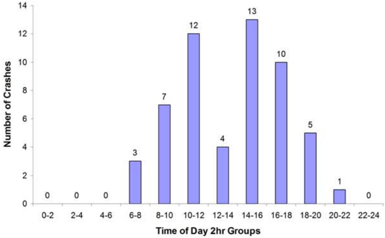


Crash by Day of Week
(9 Cross Intersections)
Number of Crashes
Day of Week
MON
TUE
WED
THU
FRI
SAT
SUN
26
24
22
26
35
19
10

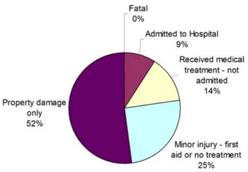
DCA Column Groups (6 T-Intersections)



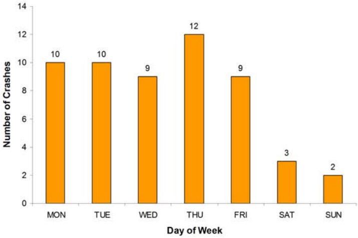
Crash by Time of Day (6 T-Intersections)

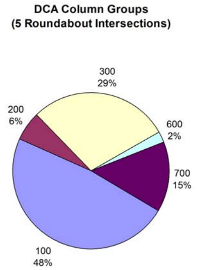


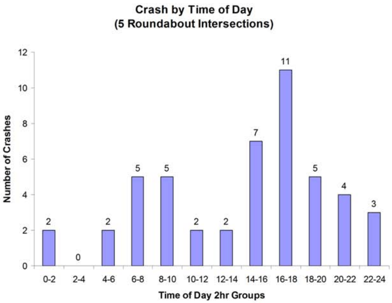
Crash by Severity (6 T-Intersections)

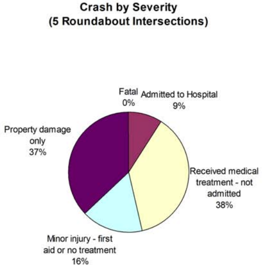


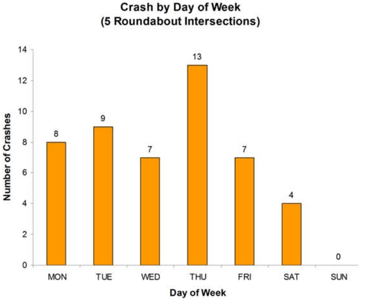
Crash by Day of Week (6 T-Intersections)

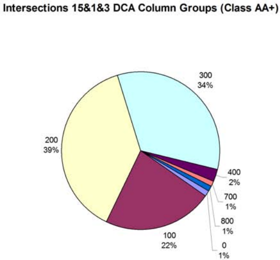


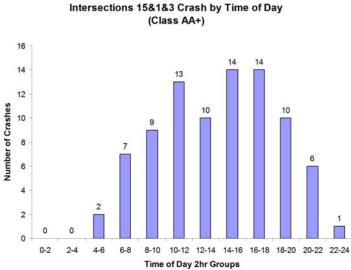

DCA Column Groups
(5 Roundabout Intersections)
300
29%
200
6%
600
2%
700
15%
100
48%

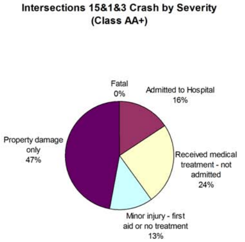

Crash by Time of Day
(5 Roundabout Intersections)
Number of Crashes
Time of Day 2hr Groups
0-2
2-4
4-6
6-8
8-10
10-12
12-14
14-16
16-18
18-20
20-22
22-24
2
0
2
5
5
2
2
7
11
5
4
3

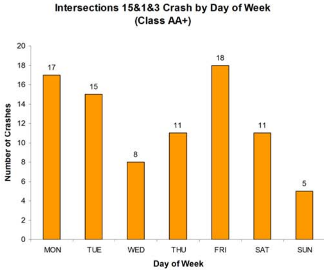

Crash by Severity
(5 Roundabout Intersections)
Fatal
0%
Admitted to Hospital
9%
Property damage only
37%
Received medical treatment - not admitted
38%
Minor injury - first aid or no treatment
16%

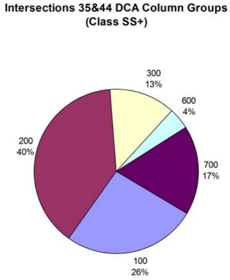

Crash by Day of Week
(5 Roundabout Intersections)
Number of Crashes
Day of Week
MON
TUE
WED
THU
FRI
SAT
SUN
8
9
7
13
7
4
0


Intersections 15&1&3 DCA Column Groups (Class AA+)
300
34%
200
39%
400
2%
700
1%
800
1%
0
1%
100
22%

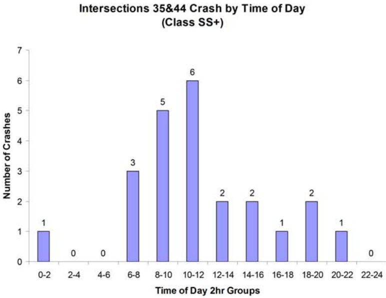

Intersections 15&1&3 Crash by Time of Day
(Class AA+)
Number of Crashes
Time of Day 2hr Groups
0-2
2-4
4-6
6-8
8-10
10-12
12-14
14-16
16-18
18-20
20-22
22-24
0
0
2
7
9
13
10
14
14
10
6
1


Intersections 15&1&3 Crash by Severity
(Class AA+)
Fatal
0%
Admitted to Hospital
16%
Received medical treatment - not admitted
24%
Minor injury - first aid or no treatment
13%
Property damage only
47%

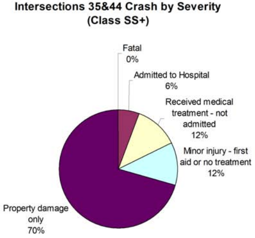

Intersections 15&1&3 Crash by Day of Week
(Class AA+)
Number of Crashes
Day of Week
MON
TUE
WED
THU
FRI
SAT
SUN
17
15
8
11
18
11
5



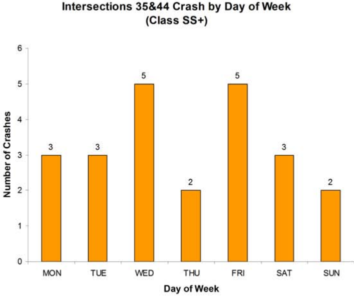
Intersections 35&44 DCA Column Groups
(Class SS+)
300
13%
600
4%
200
40%
700
17%
100
26%



Intersections 35&44 Crash by Time of Day
(Class SS+)
Number of Crashes
Time of Day 2hr Groups
0-2
2-4
4-6
6-8
8-10
10-12
12-14
14-16
16-18
18-20
20-22
22-24
1
0
0
3
5
6
2
2
1
2
1
0

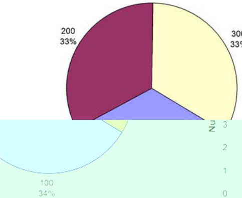


Intersections 35&44 Crash by Severity
(Class SS+)
Fatal
0%
Admitted to Hospital
6%
Received medical treatment - not admitted
12%
Minor injury - first aid or no treatment
12%
Property damage only
70%

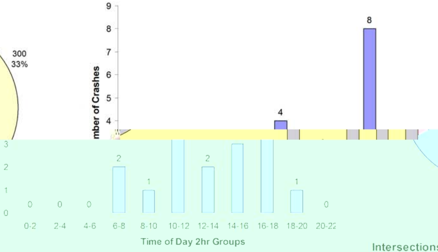


Intersections 35&44 Crash by Day of Week
(Class SS+)
Number of Crashes
Day of Week
MON
TUE
WED
THU
FRI
SAT
SUN
3
3
5
2
5
3
2

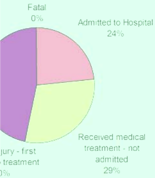
Intersections 33&89 DCA Column Groups (Class LA+)



Intersections 33&89 Crash by Time of Day
(Class LA+)

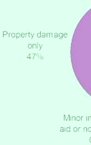


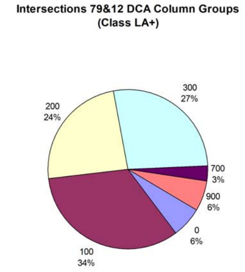
s 33&89 Crash by Severity
(Class LA+)

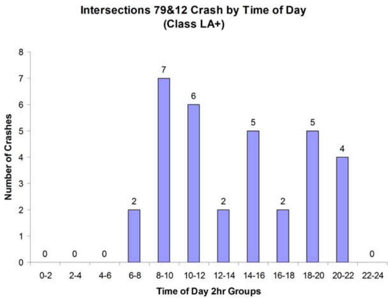


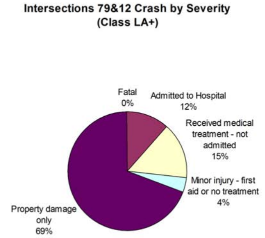
Intersections 33&89 Crash by Day of Week
(Class LA+)

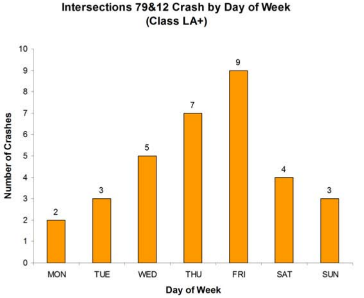
Intersections



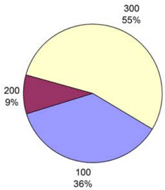

Intersections 79&12 DCA Column Groups
(Class LA+)
300
27%
700
3%
900
6%
0
6%
100
34%
200
24%


Intersections 79&12 Crash by Time of Day
(Class LA+)
Number of Crashes
Time of Day 2hr Groups
0-2: 0
2-4: 0
4-6: 0
6-8: 2
8-10: 7
10-12: 6
12-14: 2
14-16: 5
16-18: 2
18-20: 5
20-22: 4
22-24: 0

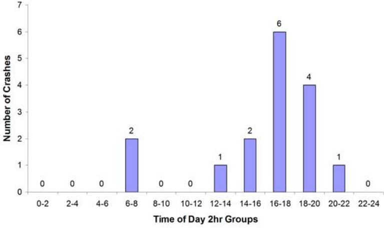

Intersections 79&12 Crash by Severity
(Class LA+)
Fatal
0%
Admitted to Hospital
12%
Received medical treatment - not admitted
15%
Minor injury - first aid or no treatment
4%
Property damage only
69%


Intersections 79&12 Crash by Day of Week
(Class LA+)
Number of Crashes
Day of Week
MON: 2
TUE: 3
WED: 5
THU: 7
FRI: 9
SAT: 4
SUN: 3

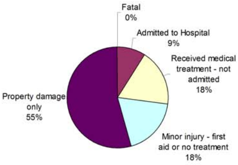
Intersections 28&47 DCA Column Groups (Class ATT)



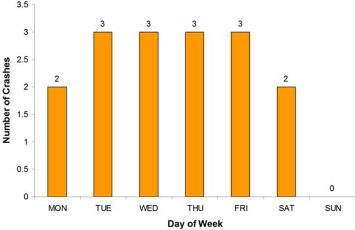
Intersections 28&47 Crash by Time of Day (Class ATT)



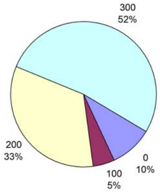
Intersections 28&47 Crash by Severity (Class ATT)



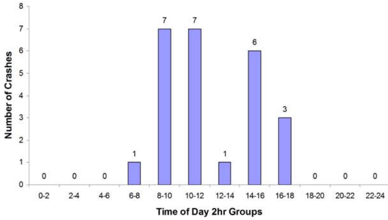
Intersections 28&47 Crash by Day of Week (Class ATT)



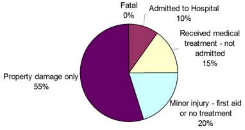
Intersections 16&94 DCA Column Groups (Class ALT)



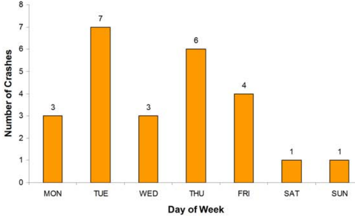
Intersections 16&94 Crash by Time of Day (Class ALT)



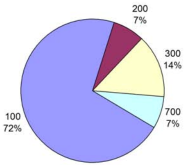
Intersections 16&94 Crash by Severity (Class ALT)



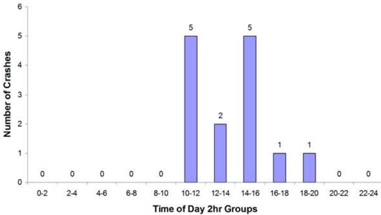
Intersections 16&94 Crash by Day of Week (Class ALT)



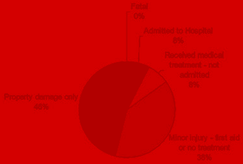
Intersections 100&65 DCA Column Groups (Class LST)



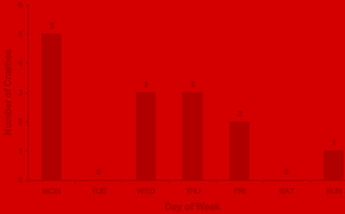
Intersections 100&65 Crash by Time of Day (Class LST)



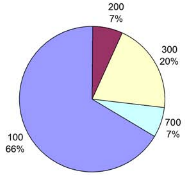
Intersections 100&65 Crash by Severity (Class LST)



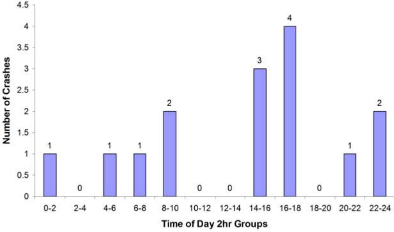
Intersections 100&65 Crash by Day of Week (Class LST)



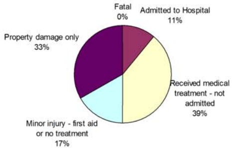
Intersections 52&98 DCA Column Groups (Class TTO)



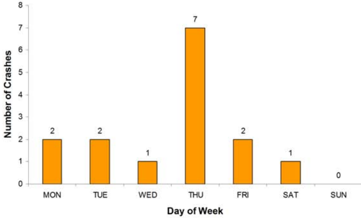
Intersections 52&98 Crash by Time of Day (Class TTO)



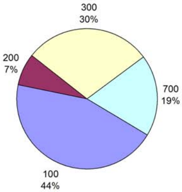
Intersections 52&98 Crash by Severity (Class TTO)



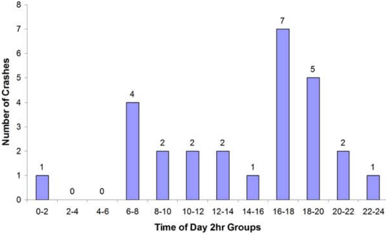
Intersections 52&98 Crash by Day of Week (Class TTO)



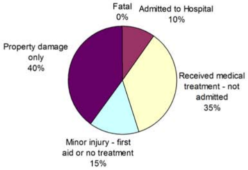
Intersections 25&80 DCA Column Groups (Class TSO)



Intersections 25&80 Crash by Time of Day (Class TSO)



Intersections 25&80 Crash by Severity (Class TSO)



Intersections 25&80 Crash by Day of Week (Class TSO)