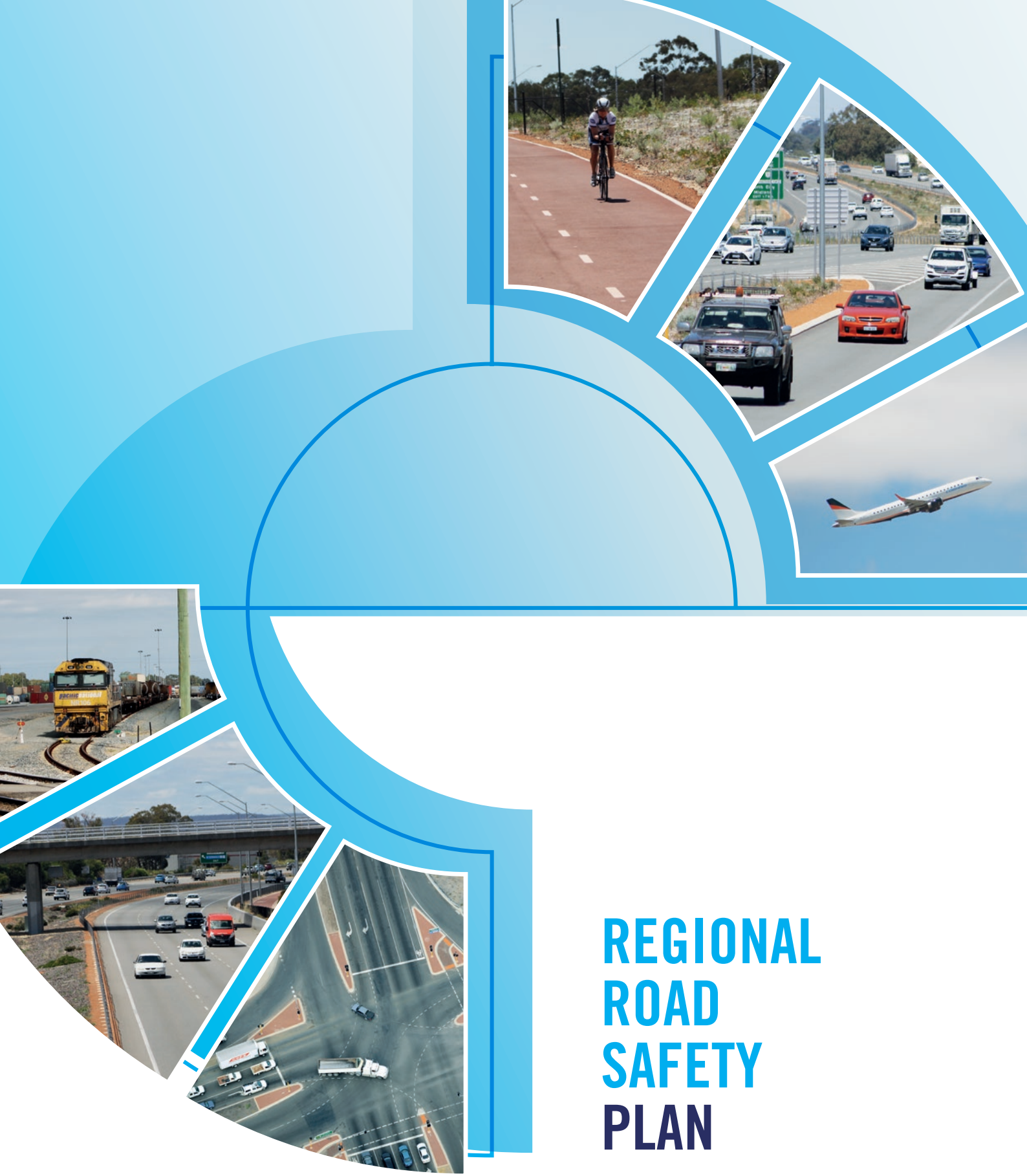

REGIONAL ROAD SAFETY PLAN

EMRC

Advancing Perth's Eastern Region


EMRC

Overview

Australia ranked 15 of 31 of the Organisation for Economic Co-operation and Development (OECD) Nations in terms of the number of annual deaths per 100,000 population in the latest statistics published in 2016. This highlights the need to review road safety on our roads. The Western Australian Government and Road Safety Commission's *Towards Zero Strategy* highlights the State's focus on reducing the number of killed and seriously injured crashes on Western Australian Roads.

Perth's Eastern Region has a strategic location in terms of transport and freight movement within the state. It has a range of competing land uses that make it challenging to have uniform transport and safety solutions for the region.

An efficient, safe and integrated transport network is critical to ensuring that the Perth's Eastern Region is able to support the predicted population and transport growth in both the region and the wider Perth metropolitan area.

The purpose of this document is to identify the blackspots and crash hotspots in the region and to provide solutions for the unique issues identified with detailed analysis from the MRWA crash data with an objective that the Road Traffic System should be configured so that no person is exposed to forces that exceed the known human tolerances for force.

This document also looks at the crash data of individual member Councils and their safety issues along with any cross boundary issues and provides recommendations and actions on ways to tackle these issues.

The EMRC's approach to safety in the transport network is to ensure that users are not exposed to harm or perceived safety risks when utilising or interacting with the network.

The EMRC has adopted a 'systems based approach' to developing a Road Safety Plan, which is in line with the strategic approaches of both the WA State Governments.

This plan will provide EMRC's member Councils with a strategic document that will have a combined vision of objectives. It provides the EMRC with actions for road safety projects including promoting education for safe road use. In addition to this it enables the EMRC to advocate for better infrastructure for the Perth Eastern Region.

The Eastern Metropolitan Regional Council (EMRC), is a progressive and innovative regional local government working on behalf of six member Councils located in Perth's Eastern Region: Town of Bassendean, City of Bayswater, City of Belmont, City of Kalamunda, Shire of Mundaring and City of Swan. A key focus of the EMRC is advocacy and this includes advocating for safer roads to help contribute towards achieving a zero road death toll. This Road Safety Plan is underpinned by the Safe System Philosophy.

This Road Safety Plan has a vision:

The EMRC advocates for and provides support to member Councils to promote and work toward achieving a road transport system where all road users are safe.

TOWN OF BASSENDEAN
Home by the Swan

CITY OF BAYSWATER
The Garden City - Quality Lifestyle

BELMONT • CITY OF OPPORTUNITY

City of Kalamunda

Shire of MUNDARING

city of swan

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Appendices

A: Safety Workshop Summary

B. Science of Crash Force Tolerance – Vehicle Mass and Velocity

1. Introduction

1.1. Eastern Metropolitan Regional Council

The EMRC works to facilitate integrated transport planning initiatives to provide an efficient, safe and integrated regional transport network and delivers a number of initiatives to support this goal. The provision of an efficient and safe transport network in Perth's Eastern Region is a critical issue for both local and state government, particularly with the predicted population growth for Perth in the future. In 2017/2018, the EMRC delivered a number of key initiatives in the areas of road safety, public transport and active transport.

Perth's Eastern Region (PER) represents approximately 35% of Perth's metropolitan area. It has an interesting mix of land uses ranging from residential, industrial and commercial. The PER has a unique topography, occupying the north-east sector of the Swan Coastal Plan, and up the Darling Escarpment. This contributes significantly to the road trauma risk of the region, especially along major corridors (particularly, for example, Greenmount Hill), and on the extensive network of roads supporting access to the Perth Hills. Owing to the escarpment terrain, historic nature of the town centres, constraints along arterial roads in established urban areas and the tight geometry of roads in the Perth hills it gives rise to unique road safety risks.

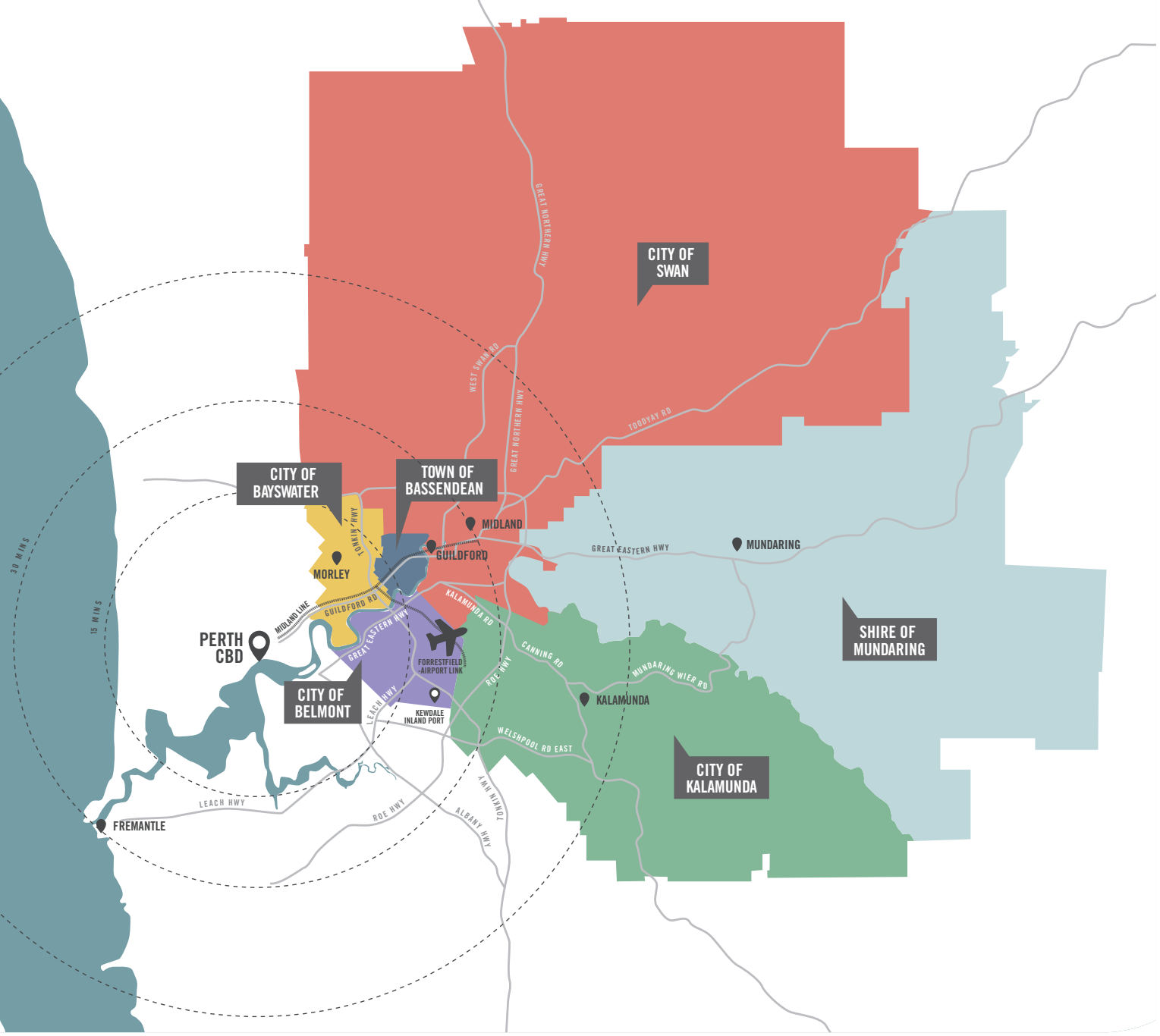
The Region has arguably one of Western Australia's most important pieces of infrastructure i.e the Perth Airport. The Airport is the premier international, domestic and regional gateway to Western Australia and has experienced significant growth in passenger movements increasing in the past decade. It has a distinctive position in transport being the primary hub for civil aviation, rail and road transportation with the intermodal freight terminals (airport and railway terminal infrastructure) and regional/interstate connections. The Region includes the Kewdale Intermodal Terminal, an important strategic component of the freight network in Western Australia due to its accessibility by road and rail and its proximity to industrial areas.

PER is Western Australia's primary hub for international and domestic airport terminals and a number of intermodal freight terminals. Being the primary freight hub, it will continue to form a major role in the interface between rail, aviation and road for decades to come. It also has major industrial presence especially construction and resource markets with areas such as Malaga, Kewdale, Belmont, Bayswater/Bassendean, Hazelmere, Midvale, Forrestfield, and Bullsbrook. These locations are high trip generators as they are key employment hubs and include key strategic roads.

The region is also the interface for the majority of heavy regional traffic to, from, and through the Perth Metropolitan Region, particularly through Great Northern Highway, the future Perth Darwin National Highway and Perth Adelaide National Highway, Great Eastern Highway, Reid Highway, Roe Highway and Tonkin Highway. These transport and industrial concentrations provide both opportunities and issues for the region.

Extensive upgrades to public transport in the PER are either being delivered or are in the planning stage, as the Forrestfield Airport Link nears completion, and METRONET Stage 1 planning for the Ellenbrook line, new Bayswater Station, and Bellevue extension progress. These projects also pose a significant opportunity to reduce road trauma through promoting mode share.

In addition to this, the Perth Hills, comprising of the Mundaring and Kalamunda Town Sites, are also a popular on-road cycling area, where roads are often shared between cyclists, heavy and light vehicles. Perth's Eastern Region is truly unique, with these characteristics having a considerable influence on travel behaviour and motivation.



In Western Australia, the majority of roads are either under the care, control and management of the State Government or local government. This Plan looks at all roads within Perth's Eastern Region, regardless of ownership. Whilst the majority of roads in the State are under the care, control and management of the respective local government, the State Government, through Main Roads Western Australia (MRWA), owns and manages roads of strategic significance including freeways and highways etc. Roads under MRWA control are subject to separate legislation and are often beyond any control or influence of the local government. This Plan looks at each local government area holistically, regardless of road ownership to help the EMRC advocate to the State and local governments for a safer road network in Perth's Eastern Region.

1.2. Road Safety in Perth's Eastern Region

A safe transport system is imperative to ensure that the community can travel around the region safely. It is also important to ensure that the economic impact of crashes is minimised, particularly in the freight industry, which is a significant driver in Perth's Eastern Region.

While congestion management and freight management initiatives are important and can be targeted at identified hotspots to alleviate congestion, longer term approaches to changing travel behaviours (both individual travel habits and wider freight industry operations) are required to create more capacity out of the existing constrained network.

This is directly relatable to this Regional Road Safety Plan, in that, evidence suggests that congested conditions lead to more frequent exposure to higher levels of poor driving behaviour, an increase in risky manoeuvres and increased impatience and road rage.

This Road Safety Plan will provide strategic guidance for the EMRC member Councils' overarching strategies to support and advocate for the reduction of the number of people killed and seriously injured on roads within the Region in line with the Western Australian State Government's *Towards Zero – Western Australia's Road Safety Strategy 2008-2020.*

1.3 Objectives

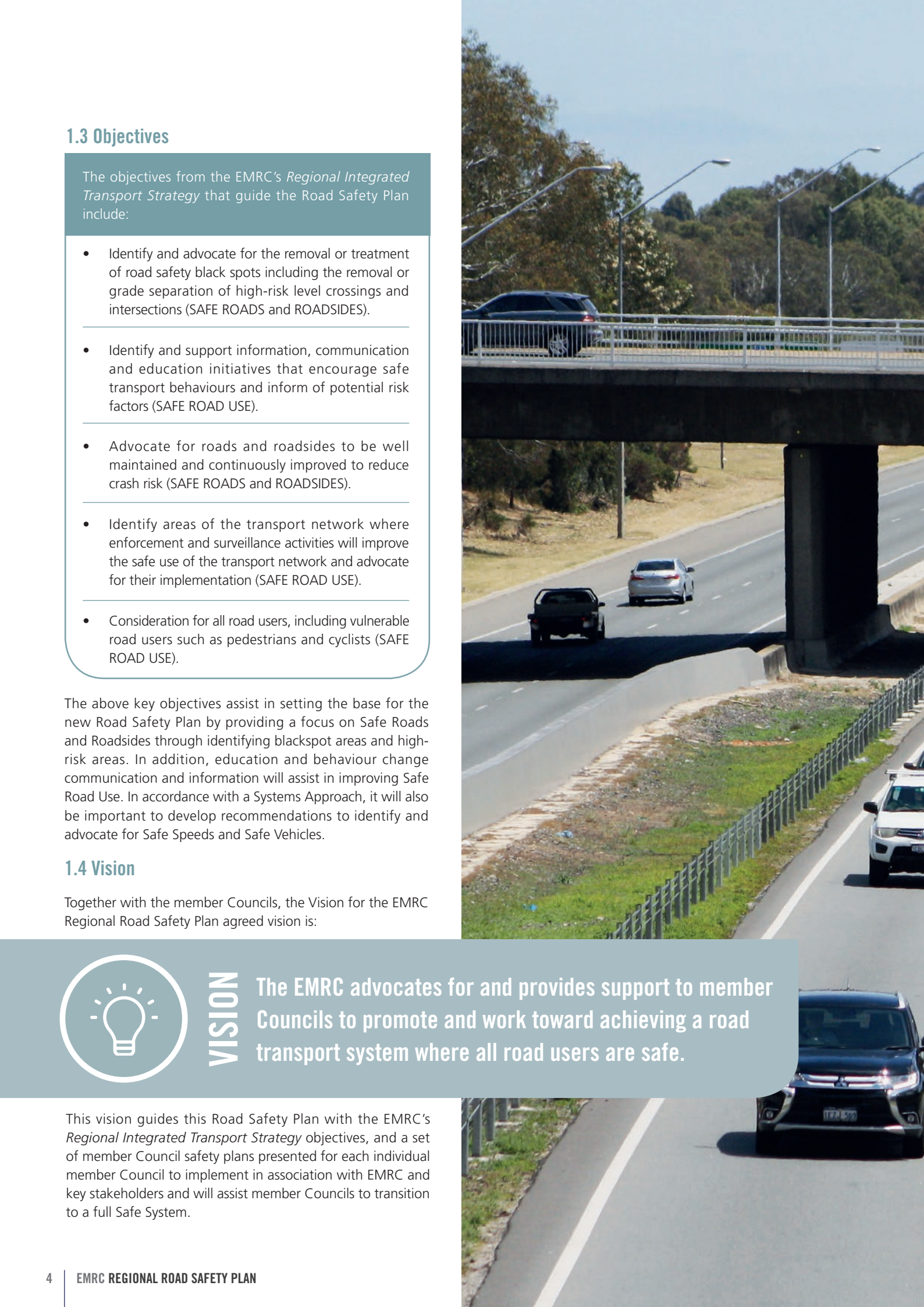
The objectives from the EMRC's *Regional Integrated Transport Strategy* that guide the Road Safety Plan include:

- Identify and advocate for the removal or treatment of road safety black spots including the removal or grade separation of high-risk level crossings and intersections (SAFE ROADS and ROADSIDES).
- Identify and support information, communication and education initiatives that encourage safe transport behaviours and inform of potential risk factors (SAFE ROAD USE).
- Advocate for roads and roadsides to be well maintained and continuously improved to reduce crash risk (SAFE ROADS and ROADSIDES).
- Identify areas of the transport network where enforcement and surveillance activities will improve the safe use of the transport network and advocate for their implementation (SAFE ROAD USE).
- Consideration for all road users, including vulnerable road users such as pedestrians and cyclists (SAFE ROAD USE).

The above key objectives assist in setting the base for the new Road Safety Plan by providing a focus on Safe Roads and Roadsides through identifying blackspot areas and high-risk areas. In addition, education and behaviour change communication and information will assist in improving Safe Road Use. In accordance with a Systems Approach, it will also be important to develop recommendations to identify and advocate for Safe Speeds and Safe Vehicles.

1.4 Vision

Together with the member Councils, the Vision for the EMRC Regional Road Safety Plan agreed vision is:



VISION

The EMRC advocates for and provides support to member Councils to promote and work toward achieving a road transport system where all road users are safe.

This vision guides this Road Safety Plan with the EMRC's *Regional Integrated Transport Strategy* objectives, and a set of member Council safety plans presented for each individual member Council to implement in association with EMRC and key stakeholders and will assist member Councils to transition to a full Safe System.

2. Current Scenario

There are a number of strategies, policies and programs that are currently adopted at various levels, both national and state government level. The EMRC have reviewed a number of strategies which are relevant to this plan.

2.1.1. National Road Safety Context

National Road Safety Strategy 2011-2020

Based on the 'safe system' approach to road safety, the National Road Safety Strategy 2011-2020 (NRSS) is a 10-year plan which sets out to reduce the annual number of crashes that result in death or serious injury. The 'safe system' approach recognises that users will make mistakes and result in crashes, however, also acknowledges that the road network should be forgiving and thus result in less death and serious injuries.

Since the initial release of the NRSS, the Australian Government initiated an inquiry into the NRSS in 2017 which was completed in 2018. The inquiry identified that implementation failure was a key issue, which was due to a lack of focus on harm elimination resulting in suboptimum results. The inquiry noted that progress was being made towards safer roads, vehicles and users, but did not make them completely safe. Two National Road Safety Action Plans, one for 2015-2017 and another for 2018 – 2020, were also prepared to support the implementation of the NRSS.

An implementation status report was also released in 2017, which identified that most Action Plan items were coded green, indicating that the action had been complete or was well advanced.

The National Road Safety Strategy 2011-2020 (NRSS) is a 10-year plan which sets out to reduce the annual number of crashes that result in death or serious injury.

Twelve key recommendations from the inquiry to measure the effectiveness of the strategy and to gauge its performance to date

1. Create strong national leadership by appointing a Cabinet minister with specific multi-agency responsibility to address the hidden epidemic of road trauma including its impact on the health system.
2. Establish a national road safety entity reporting to the Cabinet minister with responsibility for road safety.
3. Commit to a minimum $3 billion a year road safety fund.
4. Set a vision zero target for 2050 with an interim target of vision zero for all major capital city CBD areas, and high-volume highways by 2030.
5. Establish and commit to key performance indicators in time for the next strategy that measure and report how harm can be eliminated in the system, and that are published annually.
6. Undertake a National Road Safety Governance Review by March 2019.
7. Implement rapid deployment and accelerated uptake of proven vehicle safety technologies and innovation.
8. Accelerate the adoption of speed management initiatives that support harm elimination.
9. Invest in road safety focused infrastructure, safe system and mobility partnerships with state, territory and local governments that accelerate the elimination of high-risk roads.
10. Make road safety a genuine part of business as usual within Commonwealth, state, territory and local government.
11. Resource key road safety enablers and road safety innovation initiatives.
12. Implement life-saving partnerships with countries in the Indo-Pacific and globally as appropriate to reduce road trauma.

Applicable to this EMRC Road Safety Plan

The NRSS inquiry recommendations assist in the development of this Road Safety Plan noting recommendations such as adopting a Safe System approach through advocating for the accelerated uptake of safe vehicles and adopting speed management initiatives, safety focused infrastructure and developing partnerships for recommendation implementation. In addition, making road safety a genuine part of business as usual is a key for member Councils – which requires member Councils to develop a fundamental understanding and detailed knowledge of Safe System.

ANCAP safety rating works within the Safe System principles rating the safety of vehicles highlighting the increased safety benefits of the higher rated 5 star vehicles. Advocating for the uptake of 5 star or 4 star vehicles will be key to ensure safe vehicle fleet within the EMRC region.

2.1.2. Western Australian Road Safety Context

Towards Zero Road Safety Strategy 2008 – 2020

The Towards Zero Road Safety Strategy 2008 – 2020 (Towards Zero), developed by the Western Australian State Government (Road Safety Council, comprised of the Department of Education and Training, Department of Health, Insurance Commission of WA, MRWA, Department of Planning and Infrastructure, Office of Road Safety, RAC, WALGA and WA Police), aims to reduce road trauma in Western Australia through setting initiatives. Towards Zero incorporates the Safe System approach to improve road safety through the four cornerstones being Safe Road Use, Safe Roads and Roadsides, Safe Speeds and Safe Vehicles. Towards Zero sets out to reduce road trauma by 11,000 people killed or seriously injured between 2008 and 2020, which is a 40% reduction of road users killed and seriously injured each year between 2005 and 2007 (base line). Key principles include:

1. The limits of human performance
2. The limits of human tolerance to violent forces
3. Shared responsibility
4. A forgiving road system
5. Increased use of public transport.

It is noted that the WA State Government is currently (2019) developing a new Road Safety Strategy to guide the State's Road Safety through to 2050. While the strategy will be assessing a 'business as usual' model in terms of how we currently address road safety, it will also assess the impact when the Government introduces significant step changes such as increased investment or infrastructure changes or reduction of speed limits e.g. reduction of speed limits by 10 km/hr does reduce the occurrence and severity crashes and is proved by statistical evidence.

2.1.3. WALGA Initiatives

RoadWise Program

The Western Australian Local Governments Association's (WALGA) RoadWise Program works with local governments to support the implementation of Towards Zero. It is supported by the Road Safety Council of WA and funded by the State Government. As part of the RoadWise Program, many initiatives and campaigns have been undertaken including the Blessing of the Roads, Child Car Restraints, Coffee Stop Program, Community Safe Speed Promise, Driver Reviver Program, Fleet Safety and the Road Ribbon for Road Safety.

The WALGA RoadWise program is also assisting local governments in embedding safe system in their committees and policies e.g. 'safe vehicle policy' so that it becomes part of the culture not a forced effort.

Safe System Guiding Principles for Local Governments

The purpose of the guiding principles is to encourage and enable adoption of the safe system approach by Local Governments. The guiding principles provide clarity when reviewing policies and practices and they ensure provisions are included to address the safe system approach and Towards Zero strategy.

Towards Zero defines six key safe system foundation initiatives crucial to support the successful implementation of the strategy objectives.

1. Research, data and setting targets – to be undertaken by individual Councils for their specific issues.
2. Capacity building – strengthening knowledge, skills and abilities within the organisation.
3. Leadership, commitment and community support – engaging the community.
4. Partnerships and alliances – active progression of mutual objectives between relevant organisations.
5. Coordination – alignment of interventions and management functions at all levels.
6. Monitoring and reporting – systematic and continual measurement of outcomes.

These key safe system foundation initiatives provided the basis for the development of the Safe System Guiding Principles for Local Government, illustrated in Figure 2.1.

Figure 2.1: Safe System Guiding Principles for Local Government

Central to the guiding principles is the overarching principle *Local Government commits to working towards a future of zero road fatalities and serious injuries, which encompasses the aspirational vision of Towards Zero and the safe system approach.*

Road Safety Around Schools

The *Road Safety Around Schools Guidelines* have been prepared by WALGA. The Guidelines focus on the safe travel of children to and from schools. There are two different editions, one for local governments and one for schools. The Guidelines provide information on the major road safety issues around schools and methods of improving or maintaining safety around schools. Resources provided to school as part of this initiative include signage templates such as footprints and stop signs.

School Drug Education and Road Aware (SDERA)

School Drug Education and Road Aware (SDERA) provides support to schools, early learning centres and community agencies across Western Australia, and is funded by the Department of Education (WA), Mental Health Commission and Road Safety Commission.

SDERA's mission is:

To educate young people to make safer choices for their health and wellbeing, and the prevention of road related injuries and harms from drug use.

With a vision of:

Drug and road safety education for every young person in WA.

SDERA targets early childhood, primary school and secondary school children, and raises awareness about alcohol and drugs, road safety and driver awareness.

Directions 2017-19 WA's Road Safety Education Action Plan

Directions 2017-19 was produced by SDERA in consultation with member agencies of the Western Australian Road Safety Education Commission (WARSEC). It aims to support safe road use through road safety education and sets out three priorities.

1. Build a positive road safety culture in schools and early childhood services
2. Promote safe behaviours among young road users
3. Strengthen leadership and collaboration of road safety education in WA.

These three priorities aid to create a safer road environment through creating a culture where there is shared road safety responsibility and increasing awareness of road safety issues such as seatbelts, alcohol, speed and fatigue.

Supporting programs include Constable Care, Smart Steps, Parenting Connections WA, Keys for Life, Right Track and Changing Health Act together (CHAT).

Applicable to this EMRC Road Safety Plan

The Regional Integrated Transport Strategy as part of the safety priority area identifies road safety as a shared responsibility across both local and state government agencies to work toward a safer road transport network.

WALGA and the RoadWise program is a key partnership for the EMRC and its member Councils to support the implementation of this Road Safety Plan. This is not only through running road safety initiatives and events but also, more critically, to assist local governments in embedding safe system in their committees and policies.

To this extent, the development of the *Safe System Guiding Principles for Local Governments* is a key document for all member Council employees to help build Safe System knowledge for both Council employees and their community (noted within the strategy objectives).

WALGA have also developed the *Road Safety Around Schools Guidelines* with a specific purpose to provide information to Councils on the major road safety issues around schools and methods of improving or maintaining safety around schools and something to be encouraged with every EMRC member Council.

The SDERA targets school children in consultation with local agencies to raise awareness about alcohol and drugs and safe road use. This is further supported through the Education Action Plan with the priorities aiming to create a safer road environment through creating a culture where there is shared road safety responsibility and increasing awareness of what safe road use means.

2.1.4. EMRC Road Safety Context

The EMRC have regard for the National and State Road Safety Strategies and aligns itself with these actions where relevant.

Regional Integrated Transport Strategy 2017 – 2021

The EMRC's Regional Integrated Transport Strategy 2017-2021 identifies a number of priority areas to achieve the Strategy's vision including:

1. Safety
2. Efficiency
3. Effective and Productive
4. Resilient and Innovative
5. Socially Responsible
6. Environmentally Responsible.

As part of the safety priority area, road safety is identified as a shared responsibility across various state and local government agencies. The EMRC supports, assists and advocates for the development of a fatality and serious injury free road network in Perth's Eastern Region, which is demonstrated through the production of the *EMRC's Regional Road Safety Plan, Direction Zero 2015-2018*, and subsequent revision as part of this Plan.

To work toward the implementation of the Regional Integrated Transport Strategy an Implementation Advisory Group has been formed that consists of all member Councils and key stakeholders, such as Perth Airport, WALGA, DoT, PTA, MRWA and RAC. This Road Safety Plan is the next phase of strategic work to support the Regional Integrated Transport Strategy.

Regional Road Safety Plan, Direction Zero 2015-2018 (Direction Zero)

The previous EMRC Regional Road Safety Plan, *Direction Zero 2015-2018* (Direction Zero) advocates to reduce the overall number of fatal and seriously injured people involved in road crashes and strives for a 40% reduction in the number of people killed or seriously injured by 2020 from a 2005-2007 baseline. The Plan sets the target, key performance indicators and an analysis of where and why crashes occur.

The following are the key focus areas that were identified to be:

- Safe Roads and Roadsides
- Safe Speeds
- Safe Road Use
- Safe Vehicles
- Road Safety Planning and Governance.

Road safety is a shared responsibility, which is evident through the various road safety strategies and plans prepared by various agencies at local, state and federal level, as well as in a regional context.

2.2. Road Safety Record

With Australia's population growing, there are more people on the road and therefore more people at the risk of a road related death or injury. The majority of road deaths occur in regional areas; however, the majority of serious injuries occur in metropolitan areas. Whilst it is important to avoid fatalities, it is also important to avoid serious injuries, as these can significantly impact lives. Nationally, there are currently no systems to measure national indicators of serious (non-fatal but disabling) crashes. In this Road Safety Plan, crashes requiring hospitalisation have been considered as a serious injury and are also looked at in further detail.

2.2.1. Australia

In 2017, there were a total of 1,223 road deaths in Australia. These included drivers or passengers of a motor vehicle, motor cyclists (or their passenger), pedestrians or cyclists, as shown in Figure 2.2. There has been no consistent trend in the total number of fatalities, as shown Figure 2.5.

Figure 2.2: Number of fatalities by Road User Type in 2017[1]

Motor Vehicle
66%
802 Fatalities

Motor Cycles
17%
211 Fatalities

Pedestrians
13%
161 Fatalities

Bicycles
3%
39 Fatalities

Other/Unknown
1%
10 Fatalities

Whilst the highest number of fatalities occurred in New South Wales, followed by Victoria and Queensland (see Figure 2.3), when looking at the rate of fatalities for every 100,000 of the population, the Northern Territory has more than double the national average, whilst Western Australia and Tasmania have the second highest rate, both above the national average (see Figure 2.4).

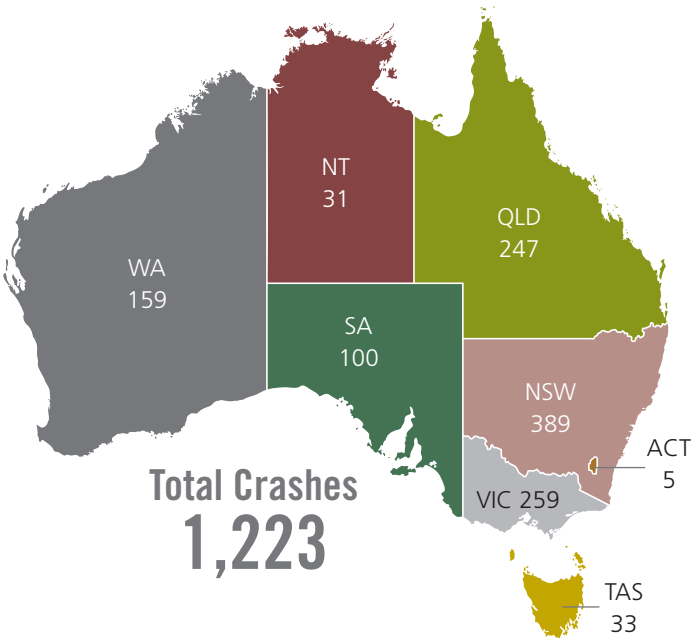


Figure 2.3: Total number of fatalities per state in 2017

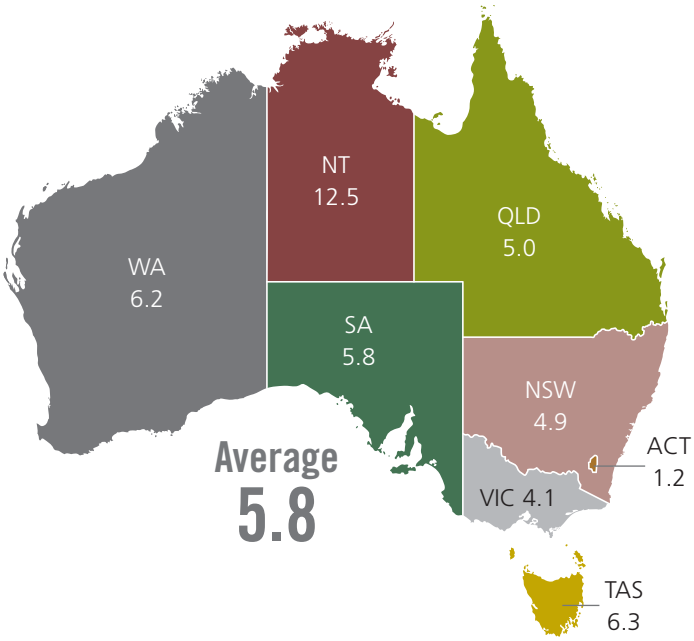


Figure 2.4: Fatality rate per 100,000 of the population 2017

1 https://www.bitre.gov.au/statistics/safety/fatal_road_crash_database.aspx

2 https://www.rsc.wa.gov.au/Statistics/Latest-Statistics

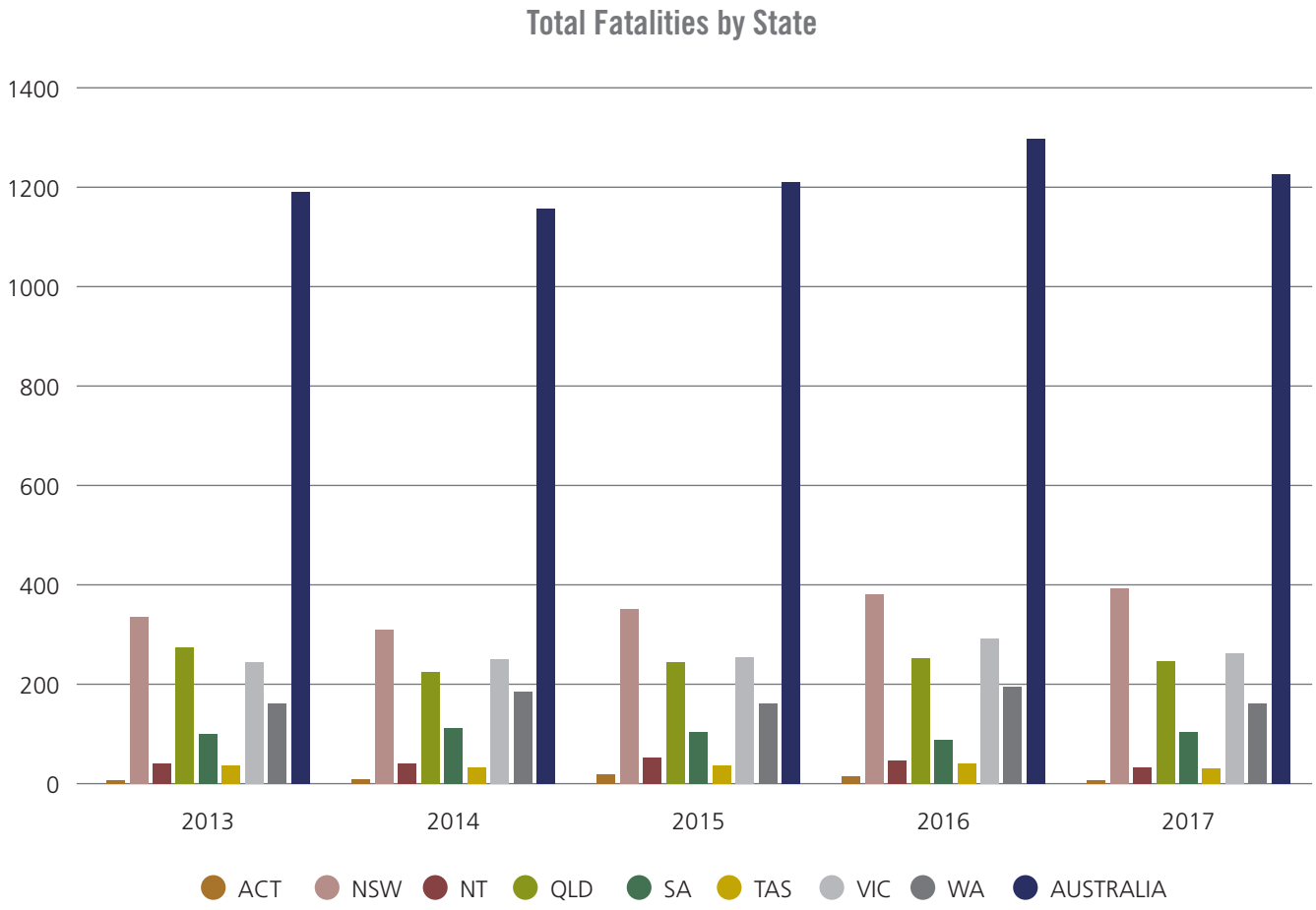
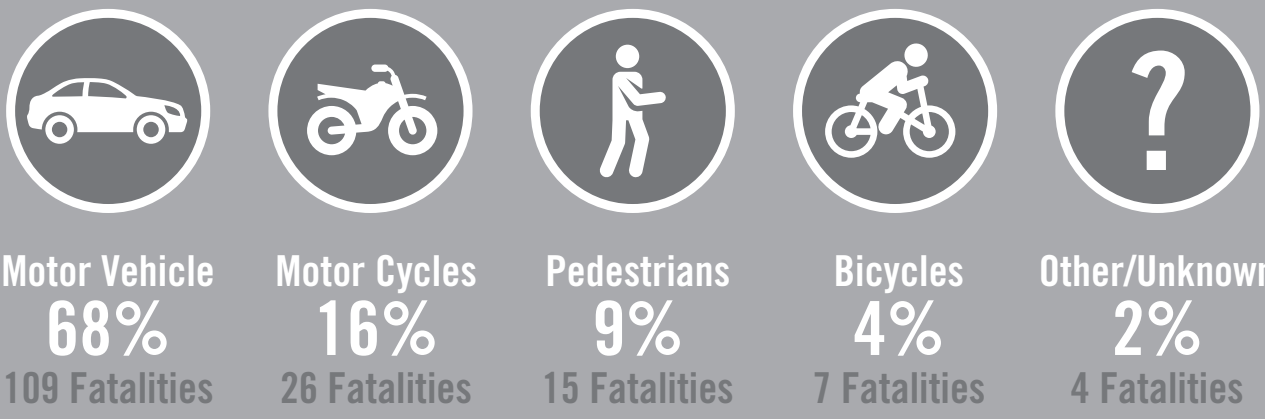


Figure 2.5: Total number of fatalities per state between 2013 and 2018

2.2.2. Western Australia

In 2017, there were a total of 161 fatalities in WA[2]. Of the 161 fatalities, 70 occurred in Metropolitan Perth whilst 91 occurred in Regional WA.

Figure 2.6: Fatalities in Western Australia by Road User 2017



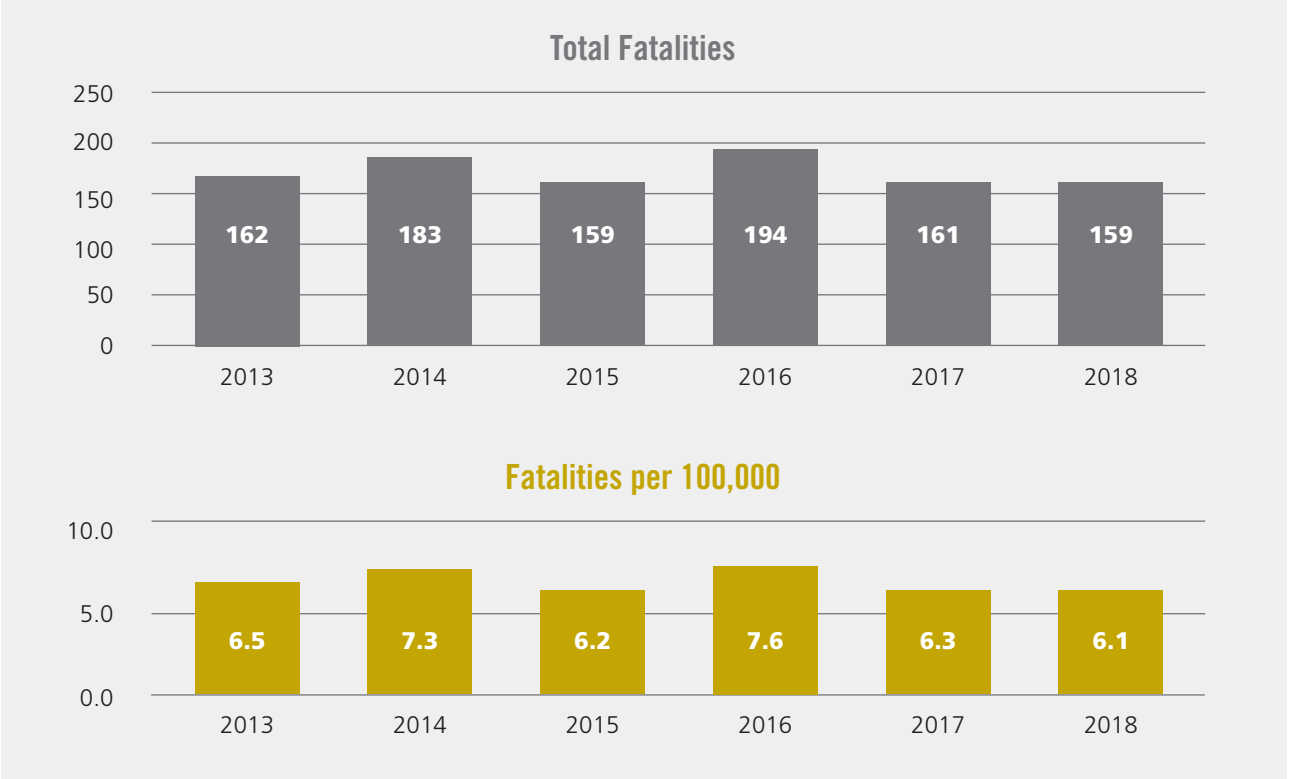
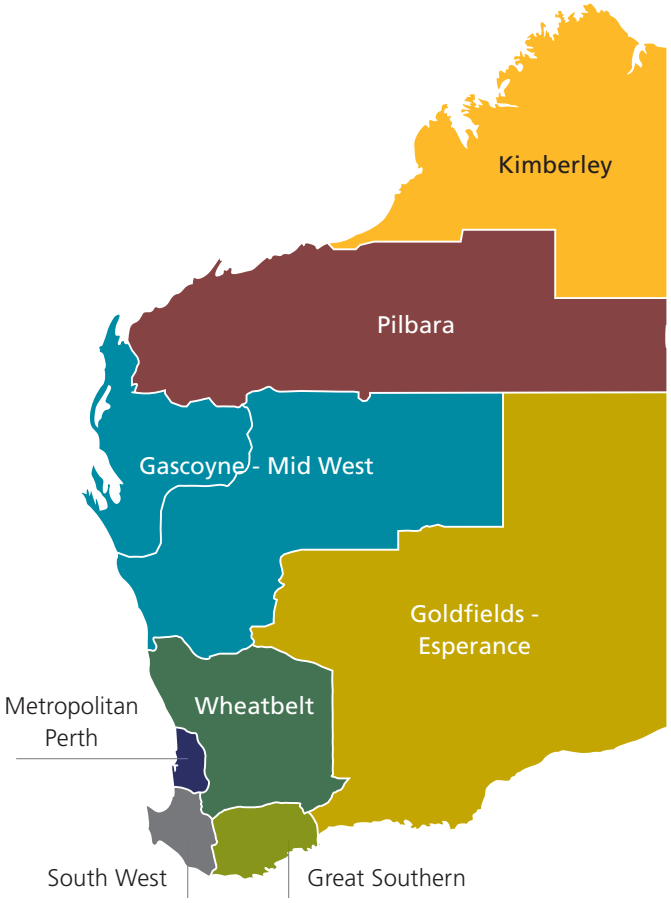


Figure 2.7: Total number of fatalities and fatalities per 100,000 population[3] in Western Australia between 2013 and 2018



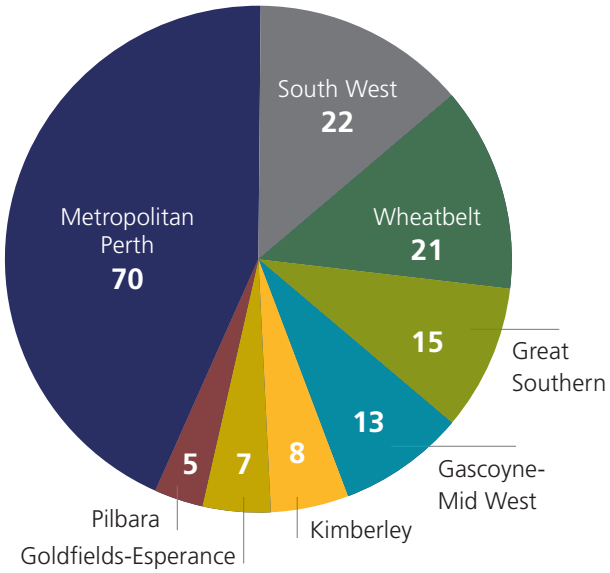


Figure 2.8: Fatalities by Region in Western Australia 2017[4]

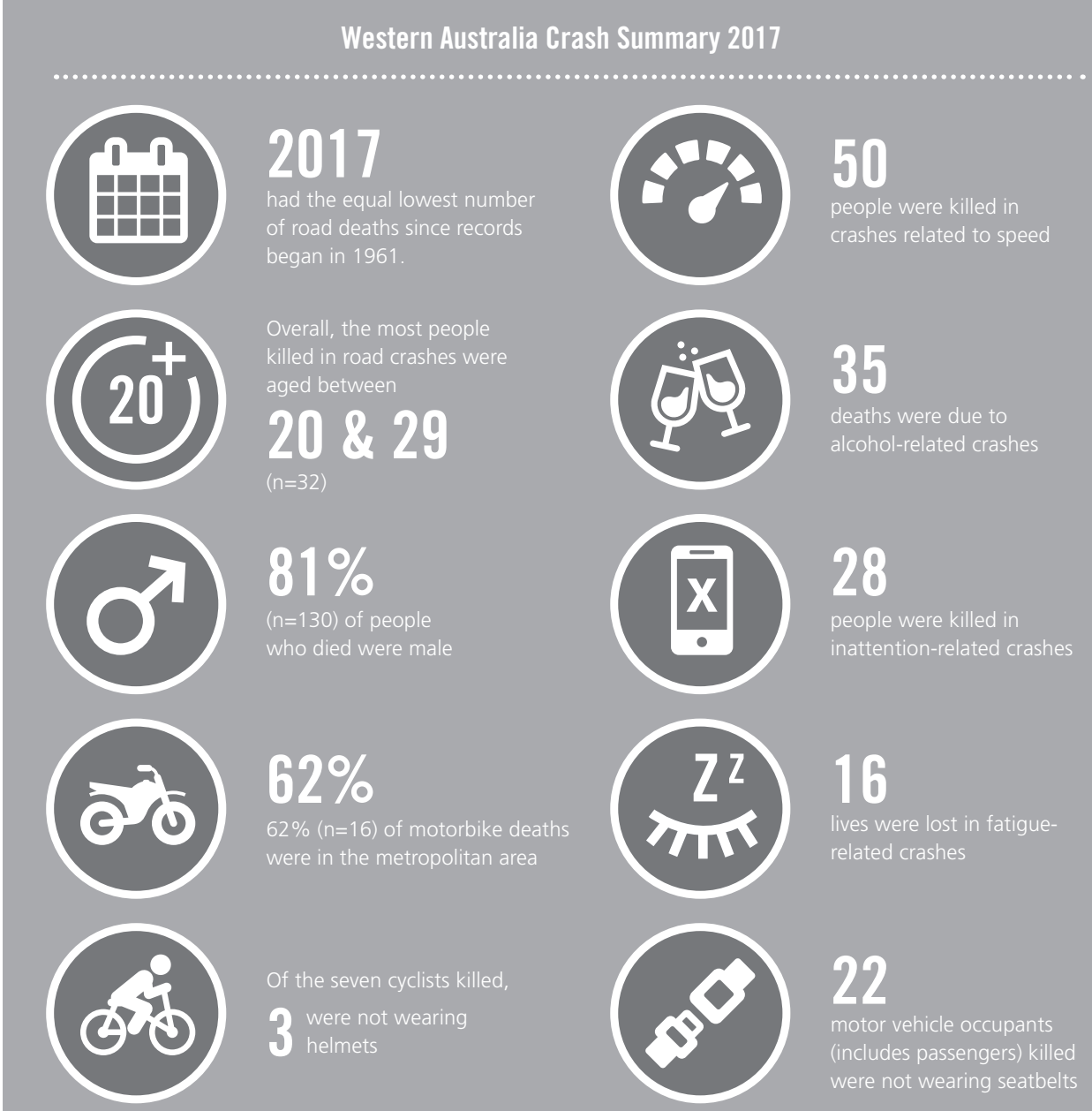


Figure 2.9: Western Australia Crash Summary 2017 (RSC 2018)[5]

The Road Safety Commission's (RSC) *2017 Preliminary Summary of Fatalities on Western Australian Roads* highlighted a few key features of the road fatalities in Western Australia in 2017. Of note is that behavioural choices such as drink driving, inattention whilst driving and not wearing a seatbelt were key causes of road based fatalities, as shown in Figure 2.9.

3 https://profile.id.com.au/australia/population-estimate?WebID=140

4 https://www.rsc.wa.gov.au/RSC/media/Documents/Road%20Data/Statistics5/Annual%20crash%20statistics/annual-prelim-crash-statistics-2017.pdf

5 Road Safety Commission's (RSC) 2017 Preliminary Summary of Fatalities on Western Australian Roads

2.2.3. Perth's Eastern Region

There were a total of 2,797 crashes in the EMRC region in 2017. Of these, there were 9 crashes[6] which involved 14 different units[5] such as motor vehicles, motor cycles, bicycles and pedestrians. There were a total of 11 lives lost in these 9 crashes[7]. 64% of the fatalities involved a vulnerable road user such as a cyclist, motorcyclist or pedestrian.

The RSC's *2017 Preliminary Summary of Fatalities on Western Australian Roads* also shows a comparison of the State and National Government's goals and the recorded fatality rates, which is shown in Figure 2.11.

Figure 2.10: Fatal crashes in 2017 within the EMRC region by road users

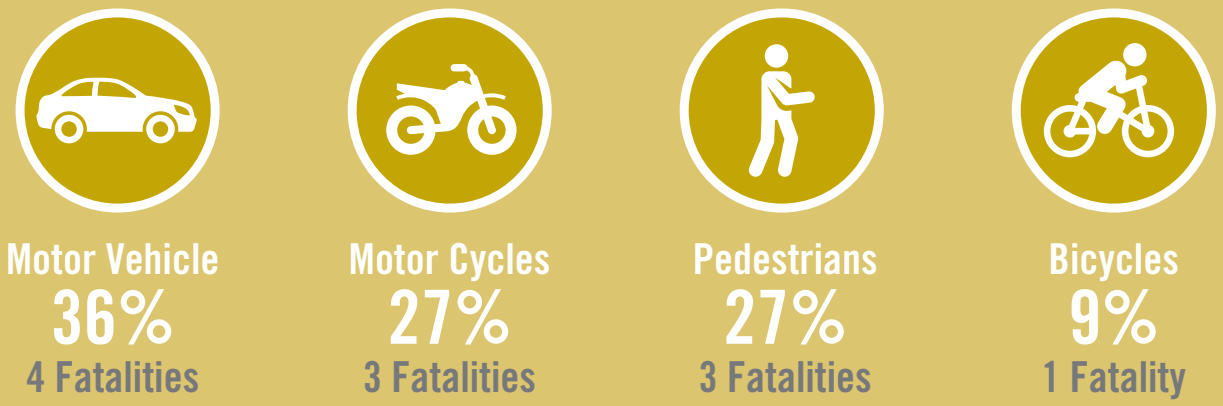


Figure 2.11: Fatality Rates per 100,000 Population (RSC 2018)

5 Road Safety Commission's (RSC) 2017 Preliminary Summary of Fatalities on Western Australian Roads

6 MRWA Crash Analysis Reporting System Data

7 BITRE Australian Road32. Deaths Database

Table 2.1 provides a summary of the fatality rate within each member Council area. The data shows that the City of Swan recorded the highest number of fatal crashes as well as crashes resulting in serious injury (hospitalisation) in 2017. The Town of Bassendean recorded the lowest number of fatal crashes and crashes resulting in serious injury. When this is assessed against the number of fatalities per 100,000 persons, the Town of Bassendean has the highest rate of fatalities per 100,000 of the usual resident population. The Western Australian average was 6.2 in 2017, where the Town of Bassendean was 6.4. The City of Swan, whilst having a high number of crashes, had the lowest number of combined KSI per 100,000 of the resident population. This is due to the large area and population of the City.

Table 2.2 lists the roads with the highest number of fatalities, whilst Table 2.3 lists the roads with the highest number of crashes requiring hospitalisation. It should be noted that this data is for the entire length of the road, and not at particular intersections. Whilst the majority of those with a higher number of fatal crashes are on higher order roads, there are a number of local roads which also have a high number of serious crashes. Of significance is West Swan Road, Mundaring Weird Road, Gnangara Road and Marshall Road, all of which have seen multiple fatal crashes.

The number of crashes which have required hospitalisation should also be taken into consideration, as a more serious crash could occur in the future. As part of a safe system approach, the EMRC will advocate to the State for further funding to assist the member Councils and acknowledgement of roads that require safety improvements, through avenues such as Black Spot Funding.

Table 2.1: Number of KSI Crashes within the EMRC Region by Member Council in 2017

	Fatal		Hospitalisation		Total	
	Number of crashes	Crashes per 100,000 people	Number of crashes	Crashes per 100,000 people	Number of crashes	Crashes per 100,000 people
EMRC Region	14	4.1	151	46.9	165	51.0
Town of Bassendean	1	6.4	9	57.6	10	64
City of Bayswater	3	4.4	26	38.0	29	42.4
City of Belmont	1	2.4	26	62.7	27	65.1
City of Kalamunda	3	5.1	26	43.9	29	49
Shire of Mundaring	1	2.6	18	46.2	19	48.8
City of Swan	5	3.6	46	32.9	51	36.5

Table 2.2: Top 10 Roads with the Highest Number of Fatalities and Hospitalisations between 2013 and 2017

Road	Road Ownership	Hospital	Fatal	Total
Great Eastern Hwy	MRWA	8	92	100
Roe Hwy	MRWA	4	36	40
West Swan Rd	City of Swan	4	19	23
Mundaring Weir Rd	City of Kalamunda / Shire of Mundaring	4	11	15
Great Northern Hwy	MRWA (north of Reid Hwy)	2	38	40
Gnangara Rd	City of Swan	2	11	13
Marshall Rd	City of Swan	2	5	7
Toodyay Rd	MRWA (East of Roe Hwy)	2	12	14
Tonkin Hwy	MRWA	1	20	21
Welshpool Road East	City of Kalamunda MRWA (Roe Hwy to Tonkin Hwy)	1	9	10

Table 2.3: Top 10 Roads with the Highest Number of Crashes requiring Hospitalisation between 2013 and 2017

Road	Road Ownership	Hospital	Fatal	Total
Great Eastern Hwy	MRWA	92	8	100
Great Northern Hwy	MRWA (north of Reid Hwy)	38	2	40
Roe Hwy	MRWA	36	4	40
Reid Hwy	MRWA	20	-	20
Tonkin Hwy	MRWA	20	1	21
West Swan Rd	City of Swan	19	4	23
Morrison Rd	City of Swan	16	-	16
Kalamunda Rd	City of Swan / City of Kalamunda	13	-	13
Toodyay Rd	MRWA (East of Roe Hwy)	12	2	14
Mundaring Weir Rd	City of Kalamunda / Shire of Mundaring	11	4	15

2.3. Crash Summary

The EMRC area has a total estimated resident population (ERP) of 366,940[8] across a total land area of 2,096km^2 with a population density of 1.75 persons per hectare. The overall population in the EMRC area has increased steadily since 2006. Each of the six local government areas vary in size, population and land use. These various features are important to note, as they reflect the need to look at each local government area individually to identify specific actions.

MRWA Crash Analysis Reporting System (CARS) provides detailed crash data and covers all intersections and midblock sections which have had one or more reported road crashes over a 5-year period from 1 January 2013 to 31 December 2017. In the five years between 1 January 2013 and 31 December 2017, a total of 25,070 crashes were recorded in the EMRC area[9]. This data has been categorised into the severity, which includes fatal, Hospitalisation required, medical attention required and property damage only (PDO) major, where the value of damage is more than $3000, and PDO minor, which the value of damage is less than $3000. Where the data was not recorded, it has been identified as 'unknown' and excluded from the analysis of that section.

A total of 25,070 crashes were recorded in the EMRC between 1 January 2013 and 31 December 2017.

Table 2.4: EMRC Member Council Crash Severity Summary

	Bassendean	Bayswater	Belmont	Kalamunda	Mundaring	Swan	EMRC Average
Fatal	0.2%	0.2%	0.1%	0.5%	0.7%	0.3%	0.3%
Hospital	4.9%	3.7%	3.1%	4.6%	7.3%	3.9%	4.6%
Medical	12.6%	14.6%	12.4%	13.6%	13.5%	15.0%	13.6%
PDO Major	53.8%	51.0%	53.0%	55.1%	54.0%	53.6%	53.4%
PDO Minor	28.4%	30.5%	31.4%	26.2%	24.5%	27.2%	28.0%

8 EMRC Profile ID 2018

9 MRWA Crash Analysis Reporting System Data

A higher percentage of fatal or seriously injured crashes are seen within the more rural member Councils such as Kalamunda and Mundaring, whilst the more urban member Councils see a higher percentage of minor crashes which result in less than $3,000 worth of property damage.

A higher percentage of crashes involving motor cyclists (including mopeds and trail bikes) is also seen within the City of Kalamunda and the Shire of Mundaring. A higher percentage of crashes involving heavy vehicles (which includes trucks, tractors, semi-trailers, road trains and buses) are also seen within these local governments, which is likely due to the higher presence of these vehicles.

A higher percentage of crashes involving pedestrians (which include pedestrians on manual scooters and skateboards as well as motorised wheelchairs) are seen in the member Councils with a higher population density such as the City of Bayswater and the Town of Bassendean. This is likely due to the increased population density as well as the inner-city nature of these member Councils.

The percentage of single vehicle crashes is also seen significantly higher in the more rural member Councils, with 23.1% of crashes within the Shire of Mundaring and 17.1% of crashes within the City of Kalamunda being a single vehicle crash, which is significantly higher than the member Council average of 12.1%. Single vehicle crashes are typically as a result of loss of control of the vehicle which may also be due to sharp turns or gravel on the road or swerving to avoid an object or animal.

Table 2.5: EMRC Member Council Crash Vehicle Type Summary

	Bassendean	Bayswater	Belmont	Kalamunda	Mundaring	Swan	EMRC Average
Bicycle	1.1%	0.9%	0.8%	0.8%	0.7%	0.9%	0.9%
Car	85.4%	89.5%	81.8%	80.3%	85.8%	82.8%	84.3%
Heavy Vehicle	4.0%	3.2%	4.4%	6.0%	6.1%	4.2%	4.6%
Motor Cycle	1.8%	1.5%	1.8%	2.8%	3.3%	1.9%	2.2%
Pedestrian	1.1%	0.9%	0.4%	0.5%	0.5%	0.6%	0.7%
Sub Total	**93.4%**	**96.2%**	**89.2%**	**90.4%**	**96.4%**	**90.3%**	**92.6%**
Unknown	6.6%	3.8%	10.8%	9.6%	3.6%	9.7%	7.4%

Table 2.6: EMRC Member Council Summary of Single Vehicle Crashes

	Bassendean	Bayswater	Belmont	Kalamunda	Mundaring	Swan	EMRC Average
Single Vehicle Crash (%)	5.6%	7.9%	7.1%	17.1%	23.1%	11.7%	12.1%

Table 2.7: EMRC Member Council Crash Vehicle Type Summary

	Bassendean	Bayswater	Belmont	Kalamunda	Mundaring	Swan	EMRC Average
Head On	0.9%	0.6%	0.4%	1.7%	1.7%	1.3%	1.1%
Hit Animal	0.1%	0.1%	0.1%	0.4%	2.0%	0.7%	0.6%
Hit Object	7.3%	5.8%	5.0%	13.2%	15.3%	8.3%	9.2%
Hit Pedestrian	2.0%	1.6%	0.8%	0.9%	0.8%	1.0%	1.2%
Non-Collision	0.5%	0.9%	0.8%	2.3%	3.2%	1.5%	1.5%
Rear End	34.1%	43.0%	51.0%	49.2%	39.6%	47.8%	44.1%
Right Angle	35.7%	24.3%	19.3%	16.9%	18.5%	19.5%	22.4%
Right Turn Through	4.8%	10.7%	6.2%	4.1%	4.1%	6.0%	6.0%
Sideswipe Same Direction	9.5%	11.7%	12.1%	9.7%	10.0%	9.9%	10.5%
Sub Total	**94.8%**	**98.7%**	**95.6%**	**98.5%**	**95.1%**	**96.0%**	**96.4%**
Unknown	5.5%	1.3%	4.4%	1.5%	4.9%	4.0%	3.6%

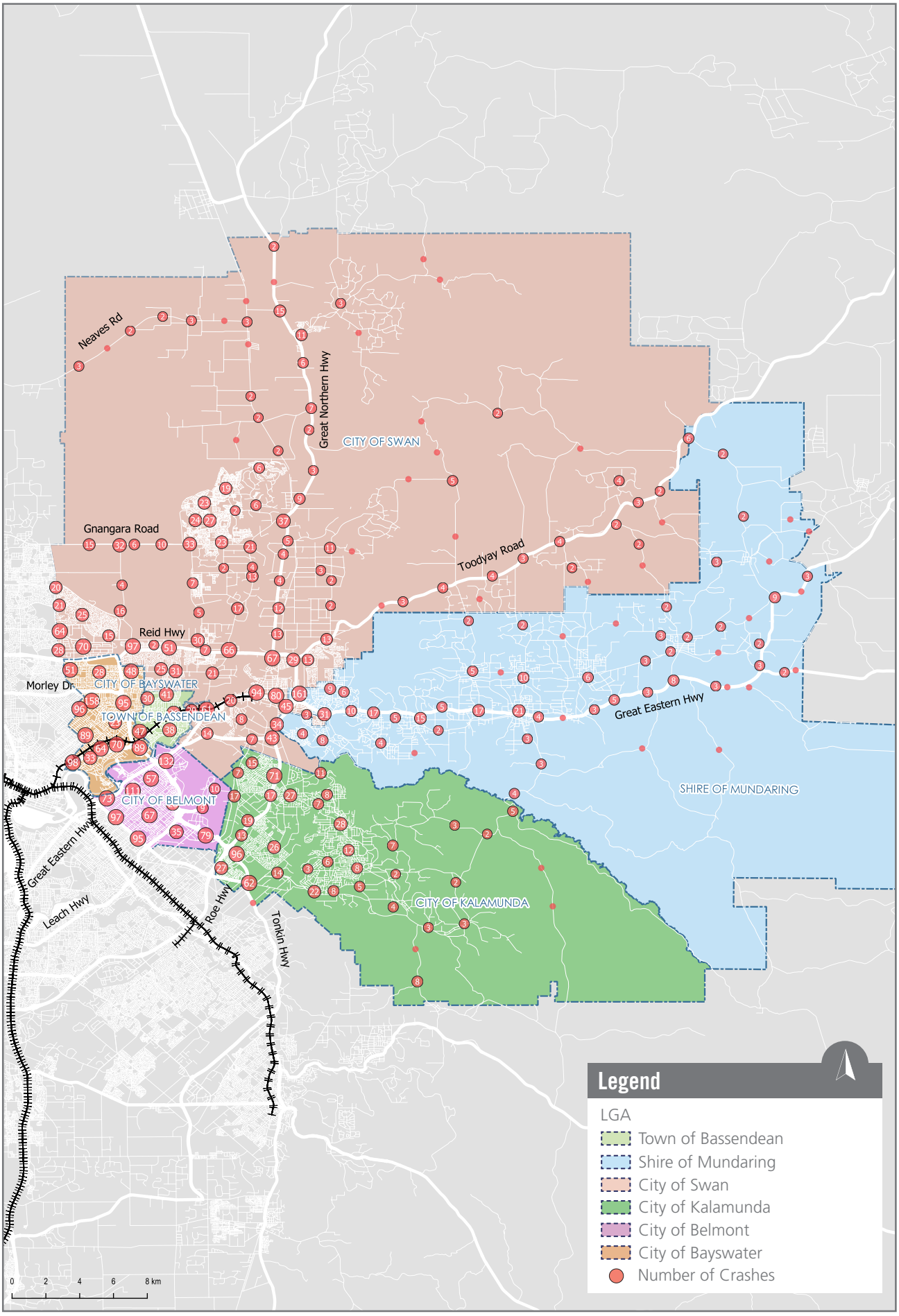
The human body is least tolerable where a vehicle hits a pedestrian or cyclist, where the risk of fatality for the target being hit increases dramatically when a vehicle travels over 30km/h

The human body is least tolerable where a vehicle hits a pedestrian or cyclist, where the risk of fatality for the target being hit increases dramatically when a vehicle travels over 30km/h. For side impact collisions such as a right angle or right turn through crash, there is a high risk of fatality for the target being hit over the speed 50km/h, whilst the risk of fatality for the target being hit increases significantly over 70km/h for frontal or hard object collisions such as hitting an object or rear end crashes.

Table 2.7 shows that in general, the most frequent type of crash in Perth's Eastern Region are rear end crashes. The member Councils with larger areas of rural zones such as the City of Kalamunda, Shire of Mundaring and City of Swan have a higher than average occurrence of head on and non-collision crashes. The Shire of Mundaring also has almost four times the EMRC area average of crashes where a vehicle hit an animal whilst both the City of Kalamunda and Shire of Mundaring have a higher percentage of crashes where a vehicle has hit an object, whilst a lower percentage of right turn through crashes.

The City of Bayswater and City of Belmont have higher percentages of right turn through crashes which typically occur at both signalised and unsignalised intersections where a vehicle is turning right.

Figure 2.12: Overall Number of Killed and Seriously Injured (KSI) Crashes within the EMRC



Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

2.4. Safety Workshop

An initial Road Safety Plan workshop (termed a Safety Workshop) was undertaken on 4 April 2019, to gather information and commence early consultation from member councils and key stakeholders. This included representatives from:

- Western Australian Local Government Association (WALGA),
- Eastern Metropolitan Regional Council (EMRC),
- RAC
- Perth Airport
- City of Swan
- City of Belmont
- Town of Bassendean
- Shire of Mundaring
- City of Kalamunda.

(Note: City of Bayswater were unavailable and as such, a separate meeting was held with them on 11 April 2019).

Representatives were asked to identify both existing and potential future key road safety and transport issues. They were also asked to consider future planning and development within their respective councils and any potential effect to road safety these may have, at either local or state government planning level.

In addition, at the end of the Safety Workshop, the advent of security against terrorist or isolated hostile vehicle mitigation attacks was discussed, noting recent events around the world (including Melbourne) and the need for Government to begin to consider this when planning and designing areas where large groups of pedestrians mass and what issues the respective member Councils may face as a result of this.

Each member Council and key stakeholder contributed to the workshop providing their insight and key issues pertinent to them.

The key themes that were discussed and drawn from the safety workshop included:

- Vulnerable road users such as gophers, an aging population, pedestrians, cyclists and school children.
- Congestion, resulting in risky behaviour as well as the associated congestion with specific intersections and level rail crossings
- Road safety including the types of crashes in respective local governments, such as single vehicle run-off road issues, traffic speed in general, hostile environments, pedestrian incidents in town centres.
- The impact of State Government projects, where key State Government projects were noted and how a lack of funding may have safety implications on the road network.

These themes, along with a review of the relevant current strategies have informed the recommendations of this Road Safety Plan.

2.5. Funding Opportunities

A number of funding opportunities for road safety and improvement projects are available to local governments in Western Australia (a few key funding sources are presented within this section). Each have their own specific qualification requirements. As recommendations from this Road Safety Plan are progressed, EMRC along with member Councils should explore these potential funding sources.

2.5.1. Black Spot Program

The Black Spot Program is a funding program to aid in road safety improvement where there is a proven crash history of high-risk location. There are two levels of funding, at the State Government level through MRWA, and Australian (Federal) Government level, through the Department of Infrastructure and Regional Development. Sites are evaluated at a benefit to cost ratio of at least 2 to 1 and focussed on cost-effective treatment of hazardous locations. The Black Spot Program also contributes towards reducing the national road toll, a target of the National Road Safety Action Plan 2018-2020, which was prepared by the Australian Government with input from State and Territory Governments.

Black Spot Program Funding Requirements

State Government

The State Government Black Spot Program is enforced through MRWA. For state roads, the State Government is the responsible party for the program, whilst for local roads, both the State Government and Local Government are responsible. A budget of $10m per year has been allocated to state roads, which is to be fully funded by the State Government, and $10m per year plus $5m of local government contribution, where funding requirements are 2/3 by the State Government, and 1/3 by the Local Government. Project costs are to be between $2,000 and $3m. The benefit to cost ratio is to be 1 to 1.

Australian Government

The Australian Government Black Spot Funding Program is enforced by the Department of Infrastructure and Regional Development, with an allocated budget of $6.585m per year. Projects are 100% funded by the Australian Government and costs are to be between $2,000 and $2m. The benefit to cost ratio is to be 2 to 1.

Figure 2.13: Example of State Government Black Spot Project – Campbell Street / Belmont Avenue, City of Belmont

2.5.2. Metropolitan Regional Road Group (MRRG)

There are two funding programs driven by the MRRG and Main Roads Western Australia, which include the Road Rehabilitation Program and Road Improvement Program. The funding for road improvements includes new projects or upgrades. Examples of works considered for the MRRG funding include new road sections, road widening and upgrades.

2.5.3. Roads to Recovery

The Roads to Recovery Program is a Commonwealth Government funding program which supports the maintenance on the nation's local road infrastructure assets. It is in line with the National Road Safety Strategy 2011-2020 to help local governments enhance safety on their road network through grant funding. Examples of projects eligible for this type of works includes resheeting and resealing existing roads for a safer network. Pedestrian and cycling facilities associated with a road can also be funded under the Roads to Recovery program.

2.5.4. Western Australian Bicycle Network (WABN) Grants

The WABN grants program is a State Government program aimed to aid local governments with the funding of cycling related projects, including infrastructure, programs and bike plans. It is a key action of the *Western Australian Bicycle Network Plan 2014-2031*, which sets out the framework for the provision of a safe and sustainable cycling network across the state. There are two types of grants programs, with one for metropolitan local governments and one for regional local governments. There are also grants available for the planning, design and construction of Safe Active Streets.

3. A systems approach to tackle road safety

3.1. Safe System and Crash Force Tolerance

3.1.1. What is a Safe System?

Safe System is a road safety approach adopted by National and State Governments to generate improvements in road safety. The Safe System approach is underpinned by three guiding principles:

- people will make mistakes on our roads but should not be killed or seriously injured as a consequence;
- there are known limits to the forces the human body can tolerate without being seriously injured; and
- the road transport system should be designed and maintained so that people are not exposed to crash forces beyond the limits of their physical tolerance.

Safe System principles comprise of a holistic view of the road transport system and the interactions among roads and roadsides, travel speeds, vehicles and road users. This is an inclusive approach that caters for all groups using the road system, including drivers, motorcyclists, passengers, pedestrians, cyclists, and commercial and heavy vehicle drivers. Consistent with a long-term road safety vision, it recognises that people will make mistakes and may have road crashes, but the system should be forgiving, and those crashes should not result in death or serious injury. As such, there needs to be an increased focus on:

- Safe Road Users
- Safe Vehicles
- Safe Roads and Roadsides
- Safe Speeds.

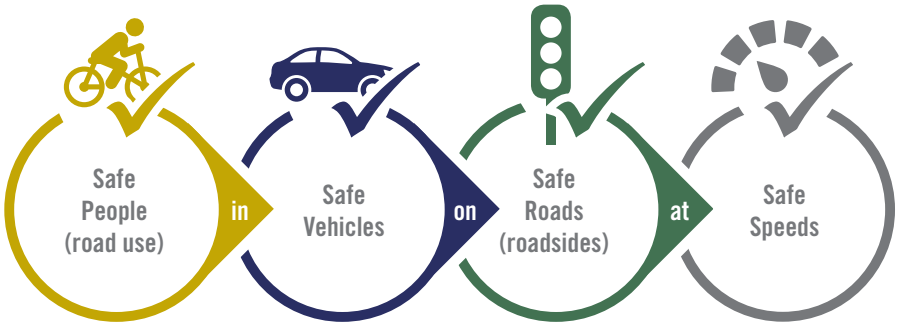


Figure 3.1: Application of the Safe Systems Principles

Safe System principles comprise of a holistic view of the road transport system and the interactions among roads and roadsides, travel speeds, vehicles and road users.

This new Safe System approach shifts away from the ideology that "it is up to every individual to survive a crash" and moves towards the ideology that "it is not acceptable for someone to die or be seriously injured as a result of a crash".

It is accepted that all roads cannot be changed immediately to a fully safe system due to the extent and length of the road network across the EMRC area along with available funds. As such, it is important for member Councils as a region to continue to upgrade and maintain the regional road network to a fully safe system and prioritise safe design improvements, safe design speed changes and promoting the greater awareness of safe vehicles over time.

For existing roads, this can be done when upgrades and maintenance is planned to include design improvements, safe speed changes and transitioning the broader vehicle fleet to safe vehicles over time in accordance with Safe System.

3.1.2. Human Tolerance to Violent Forces

A key part of the Safe Systems is accepting that humans will make errors, however infrastructure and the road network should be forgiving. A part of this is understanding the human tolerance to violent process. When designing roads, if conflicts between road users are unavoidable, we need to consider the physical forces within the limits of human tolerance, which is summarised in Figure 3.2. Speed and crash force has an impact on the human body's tolerance towards a violent force. The limits of human tolerance vary between the different types of collision, such as with a vulnerable road user (i.e. cyclists and pedestrians), roadside hazards, side-on collisions or frontal collisions.

Perth's Eastern Region

In Perth's eastern Region, the most common type of crash is a rear end crash. These crashes fit mostly in line with the frontal impact type of crash and are generally survivable. The second most common type of crash is a right-angle, or side collision type of crash. In this instance, roundabouts could be considered as a solution to minimise the impact of these types of crashes.

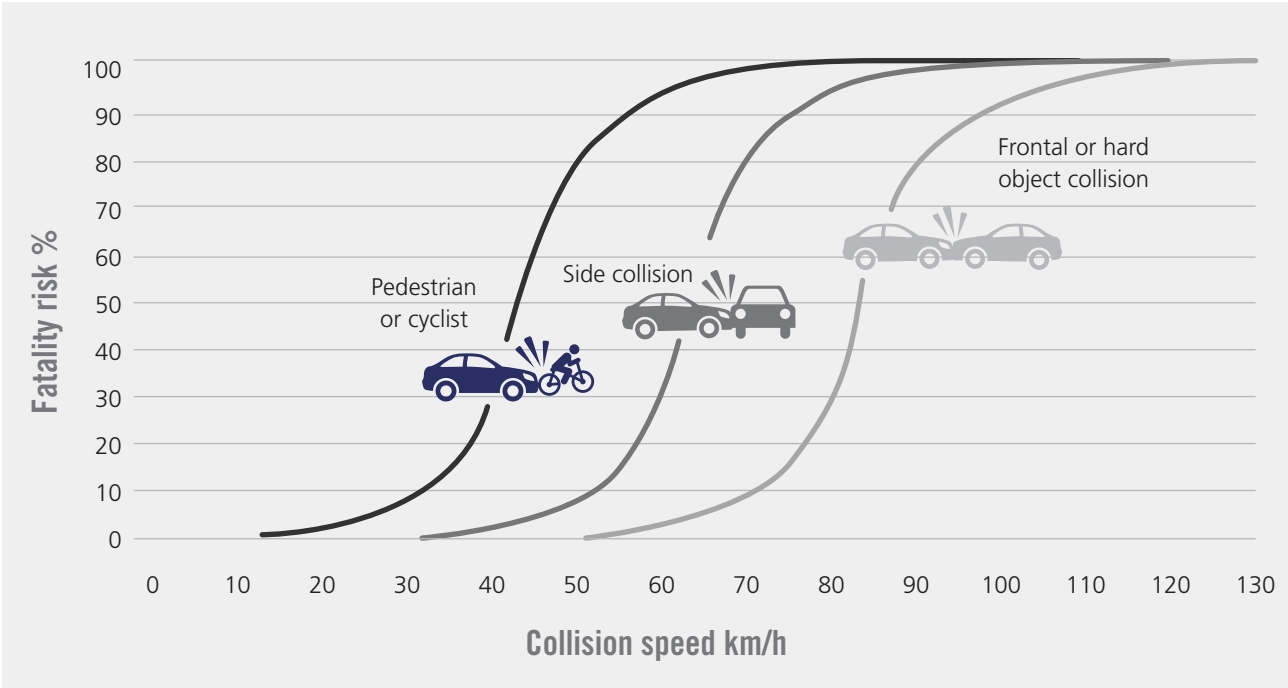


Figure 3.2: Fatality Risk Curve[10]

10 Wrambourg 2005 - https://acrs.org.au/files/arsrpe/full-paper_2019.pdf

4. Town of Bassendean Road Safety Review

4.1. Background

The Town of Bassendean has an ERP of 15,739[11] and a land area of 10km^2. The population density of the Town is 15.23 persons per hectare and is bound by the Swan River to the south and east, City of Swan to the north and east of the Swan River, City of Bayswater to the west and City of Belmont to the southern side of the Swan River. The Town is predominantly residential with supporting industrial at Ashfield Industrial Estate and commercial areas. The Town is serviced by three train stations along the Midland line. An analysis of the MRWA crash data has identified that there was a total of 810 crashes, involving 1,547 units including pedestrians, cyclists, motor cyclists, cars and heavy vehicles, between 2013 and 2017 as seen in Table 4.1.

4.2. Literature Review

Draft Bassendean Transport Plan 2018

The Town of Bassendean's Draft Bassendean Transport Plan does not specifically reference road safety. However, it does include an assessment of existing movement network (all modes) highlighting operational difficulties as well as cross boundary network issues that have an influence on Bassendean or other local governments in the area, such as a road located over two or more different local governments with different capacities and/or form or function. These issues may be traffic congestion issues and/or road safety issues. The assessment for the Plan is addressed through a network and policy SWOT analysis identifying influencing factors (both locally and at a state level) to shape the forward-facing transport and land use strategy. Through analysis, a number of proposals have been recommended within the Plan, including improved pedestrian crossing facilities, improved intersection upgrades to reduce conflicts, town centre speed limit reductions, more active transport links and safer vehicle fleet for the Town employees.

4.3. Crash Hotspots

810 crashes occurred within the Town of Bassendean area between 1 January 2013 and 31 December 2017, which involved 1,386 known units, which include bicycles, cars, heavy vehicles (including buses, trucks, semitrailers, tractors and road trains), motor cycles (including motorised scooters) and pedestrians (including motorised wheelchairs). 161 involved unit types were not recorded. The tables below give the detail of the crash statistics.

TOWN OF BASSENDEAN
Home by the Swan

Population
15,739

Land Area
10km^2

Density
15.32
persons per hectare

11 Population Estimate from ProfileID, derived from the Australian Bureau of Statistics Estimated Residential Population 2018

Table 4.1: Town of Bassendean Crash Severity

Severity	Number of Crashes	Percentage
Fatal	2	0.2%
Hospital	40	4.9%
Medical	102	12.6%
PDO Major	436	53.8%
PDO Minor	230	28.4%
Total	**810**	**100%**

Table 4.2: Town of Bassendean Type of Vehicles Involved in Crashes

Severity	Number of Crashes	Percentage
Type of Vehicle	Number of Crashes	Percentage
Bicycle	17	1.1%
Car	1,267	85.4%
Heavy Vehicles	59	4.0%
Motor Cycle	26	1.8%
Pedestrian	17	1.1%
Total (Known)	**1,386**	**93.4%**
Unknown	98	6.6%

Table 4.3: Town of Bassendean Midblock vs Intersection Crash

Location	Number of Crashes	Percentage
Intersection	507	62.6%
Midblock	303	37.4%
Total	**810**	**100%**

Table 4.4: Town of Bassendean Crash Type

Crash Type	Number of Crashes	Percentage
Head On	7	0.9%
Hit Animal	1	0.1%
Hit Object	59	7.3%
Hit Pedestrian	16	2.0%
Non-Collision	4	0.5%
Rear End	276	34.1%
Right Angle	289	35.7%
Right Turn Through	39	4.8%
Sideswipe Same Direction	77	9.5%
Total (Known)	**768**	**94.8%**
Unknown	42	5.5%

The crash data maps identify a few features within the Town of Bassendean area, which include:

- The highest frequency of crashes within the Town of Bassendean area occurred along the Railway Parade corridor, given the higher volume of traffic through this route. Other higher order corridors with a high frequency of crashes include Morley Drive East, Walter Road East, Lord Street and Collier Road between Morley Drive East and Railway Parade, which are all Distributor A roads. The majority of mid-block crashes have occurred along these roads and are generally within close proximity to an intersection. A corridor study can be considered for these roads to further analyse these routes. In addition to these, there have been a high number of crashes which have been recorded on a number of local roads and are discussed in the next section.
- The majority of crashes (51%) within the Town of Bassendean area have occurred where there was no sign or traffic control 35.7% of crashes were right angle crashes. Of the right-angle crashes, the majority occurred at a stop sign (39%), where there was no sign or control (33%) or at a give way sign (24%). The second most common type of crash was a rear end crash (34.1%) 44.1%. The majority of rear end crashes had occurred where there was no sign/control or at an intersection with traffic lights.
- The Town of Bassendean has a higher percentage of bicycle, car and pedestrian crashes compared to the EMRC area average, and a lower percentage of heavy vehicle and motor cycle crashes.

4.4. High Risk Areas

As mentioned in the section above a number of crashes have been recorded on local roads at intersections. Further investigation along the following roads to analyse the reasons behind crashes is recommended.

- Old Perth Road (Local Distributor)
- Anzac Terrace (Local Road)
- Broadway (Local Road)
- Palmerston Street (Local Road)
- Shackleton Street (Local Road)
- Iolanthe

Three motor cycle crashes were recorded at the intersection of **Altone Road and Morley Drive East**, resulting in one requiring medical attention and two resulting in property damage, and two at the intersection of **Anstey Road and North Road** with one requiring hospitalisation and one requiring medical attention. These intersections should be reviewed further to identify reasons for these crashes and mitigation measures to avoid any fatal crashess.

Heavy vehicle crashes have occurred along **Guildford Road and Railway Parade**, predominantly at the intersections of Jackson Street, Colstoun Road, Collier Road

A further investigation into the reasons behind and type of crashes at the following locations is recommended.

- Iolanthe Street / Collier Road (14)
- Shackleton Street / Kathleen Street (5)
- Reid Street / Kenny Street (7)
- Guildford Road / Collier Road (54).

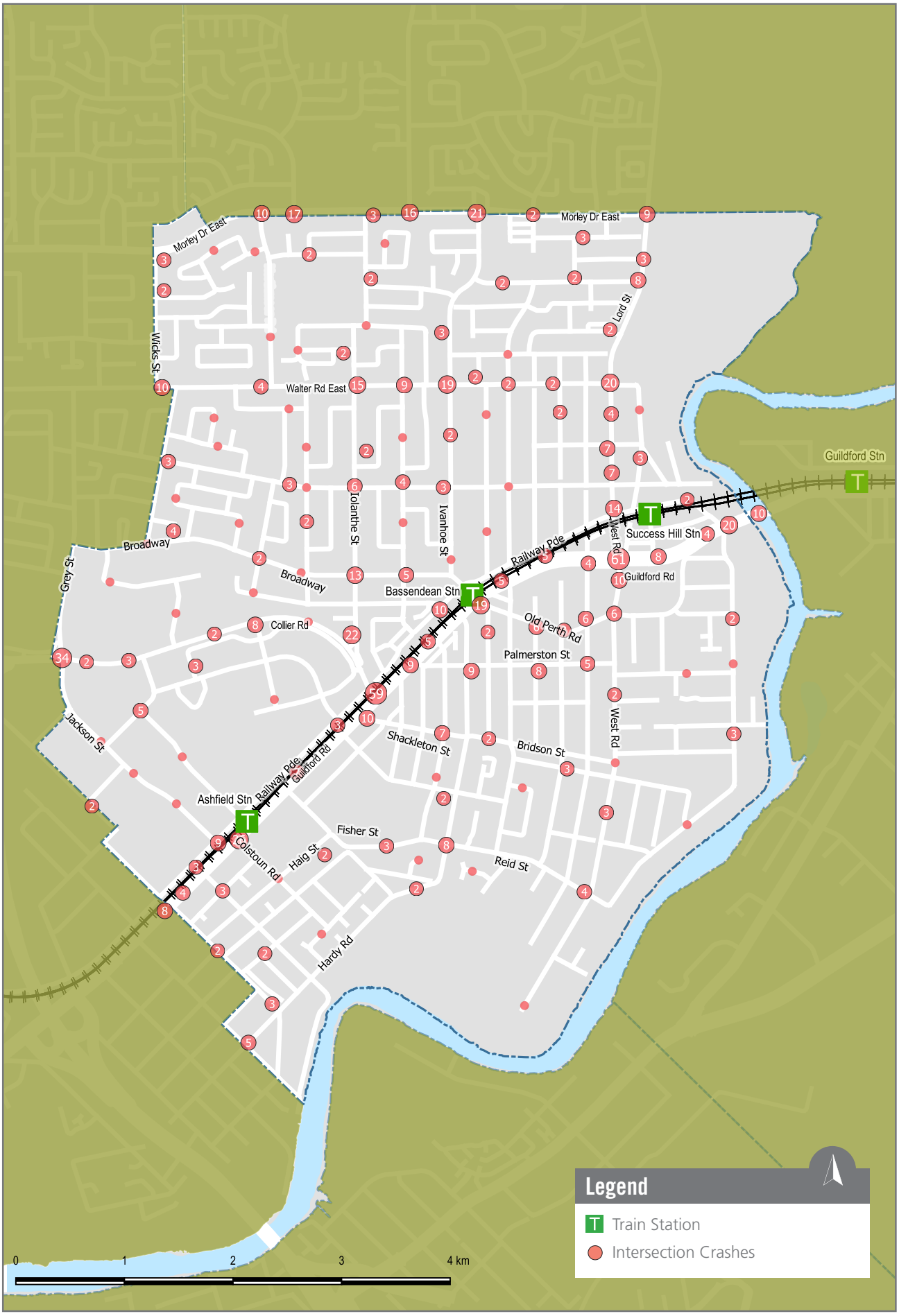
Corridor Studies recommended for the following locations that have had a high occurrence of crashes throughout the length of the roads to understand crash reasons and identify potential mitigation methods for these issues:

- Old Perth Road (28)
- Lord Street (64)
- Walter Road East (78).

Other considerations include:

- **Pedestrian crossings** – the Town has a higher than average percentage of crashes involving pedestrians.
- Intersections – the Town has a higher than average percentage of crashes that occur at intersections.

Figure 4.1: Overall Number of Crashes within the Local Government Area



Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 4.2: Overall Midblock vs Intersection Crashes within the Local Government Area

Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017


TO 55 OUTH
Belgra ia St
TURN LEFT AT
Hargr aves St
55 Bayswater
ASCOT RACECOURSE
TAXI

5. City of Bayswater Road Safety Review

5.1. Background

The City of Bayswater has a population of 68,232[12] across a total land area of 35km^2. The City of Bayswater has the highest population density of the member Councils, with a density of 19.71 persons per hectare.

The City Bayswater is bound by the City of Stirling to the west, City of Swan to the north and north-east, Town of Bassendean to the east, swan river to the south, with the Town of Victoria Park, and City of Belmont on the other side of the Swan River. The City of Baywater is serviced by four train stations on the Midland Railway Line and is serviced by Reid Highway to the north. Tonkin Highway and Morley Drive run through the City. The City has experienced an overall population growth since 2006 from 59,632 to 68,232 in 2018. However, it is noted that the population has steadily decreased annually since 2015.

Similar to the Town of Bassendean the City of Bayswater is predominantly residential with some supporting industrial and commercial areas. Given the higher population density, and proximity to the Perth CBD, there is a high proportion of higher density residential areas.

The City of Bayswater will also be affected by a number of public transport infrastructure projects as part of METRONET including the Forrestfield-Airport Link and associated upgrades to Bayswater Station and Morley-Ellenbrook Line.

The MRWA crash data for the period between 2013 to 2017 recorded a total of 5,094 crashes within the City. Of these, 11 (0.2%) were fatal, 190 (3.7%) required hospitalisation and 744 (14.6%) required medical attention. The majority of these crashes (81.5%) resulted in property damage. These 5,094 crashes involved 9,787 units, which include bicycles, cars, heavy vehicles (including buses, trucks, semitrailers, tractors and road trains), motor cycles (including motorised scooters) and pedestrians (including motorised wheelchairs).

Population
68,232

Land Area
35km^2

Density
19.71
persons per hectare

5.2. Literature Review

City of Bayswater – Strategic Community Plan 2013 – 2023

The purpose of the Strategic Community Plan is to link the community's aspirations with the City's vision and long-term strategy. However, there is minimal information specifically referencing road safety initiatives. However, the Plan does note, with its Built Environments section, develop and maintain streetscapes with a connected community with sustainable and well-maintained transport. It also notes to advocate for safe and accessible public transport.

City of Bayswater Traffic Management Schedule 2017

The City has completed a Citywide Traffic Management Study on a precinct basis last year covering the whole municipality. The Study was divided up into eight different precincts undertaken over a number of years due to the vast area and extensive network.

12 Population Estimate from ProfileID, derived from the Australian Bureau of Statistics Estimated Residential Population 2018

Table 5.1: City of Bayswater Crash Severity

Severity	Number of Crashes	Percentage	EMRC Average
Fatal	11	0.2%	0.3%
Hospital	190	3.7%	4.6%
Medical	744	14.6%	13.6%
PDO Major	2,596	51.0%	53.4%
PDO Minor	1,553	30.5%	28.0%
Total	**5,094**	**100%**	**100%**

The reports have identified various number of potential traffic issues within each of the precincts with recommendations prioritised to short, medium and long term.

A high-level review of the recommendations notes that the majority of recommendations will address one or more of inappropriate traffic volumes, speed or crash issues. However, they are nearly all infrastructure focused projects (signing and lining changes, minor intersection works etc) which aligns with Safe Roads and Roadsides. A few of the recommendations will address speed through traditional LATM measures, but few (if any) will address safe vehicles or safe road use. This is understandable given Safe Roads and Safe Speed is more controllable by local government, but it does represent a possible advocacy position for EMRC to look at safe road use and safer vehicles.

It is noted there are only a few recommendations aimed at improving vulnerable road user infrastructure and safety.

5.3. Crash Hotspots

5,094 crashes were recorded within the City of Bayswater between 1 January 2013 and 31 December 2017, which involved 8,729 known units, which include bicycles, cars, heavy vehicles (including buses, trucks, semitrailers, tractors and road trains), motor cycles (including motorised scooters) and pedestrians (including motorised wheelchairs, skateboards and manual scooters). It is noted that the vehicle type data for the 750 vehicles were not recorded. Of the known units, 85.7% involved cars, whilst 3.3% involved vulnerable road users including bicycles, motor cycles and pedestrians. The majority of crashes within the City of Bayswater occurred at intersections(62.5%) which is similar to the EMRC area average of 59.7%.

The crash data maps identify a few features within the City of Bayswater. These are summarised below:

- The City of Bayswater had a higher percentage of car and pedestrian related crashes, and a lower percentage of heavy vehicle and motor cycle related crashes compared to the EMRC area average. The percentage of bicycle related crashes was the same as the EMRC area average. The lower percentage of heavy vehicles may, similar to the Town of Bassendean, be due to the City's higher density and inner-city nature.

- All of the higher order roads (Primary Distributor Roads and Distributor A) within the City of Bayswater have experienced a high frequency of crashes. This can be expected, given the higher volumes of traffic which would increase the opportunity for a crash to occur.
- From a high-level review, key local roads which have experienced a high frequency of crashes (more than 7 crashes over the 5-year reporting period) include:
  - Birkett Street
  - Drummond Street
  - Salisbury Street
  - Sussex Street
  - Tenth Avenue
  - Falkirk Avenue
  - Roberts Street
  - Clement Street
  - Murray Street
  - Ellesmere Road.
- Key local intersections which have experienced a high number of crashes (more than 5 crashes over the 5 years reporting period) include:
  - Sixth Avenue / Coode Street
  - King Street / Raymond Avenue
  - Sailsbury Street / Bowden Street
  - Hardey Road / Moojebing Street.

- A number of locations have been identified where a cluster of crashes involving motor cyclists have occurred. All of the locations where multiple crashes have occurred have been intersections. These intersections, and number of occurrences are listed below.
  - Whatley Crescent / Hotham Street Bridge (7)
  - Guildford Road / Peninsula Road (5)
  - Guildford Road / Whatley Crescent (5)
  - Guildford Road / Tonkin Highway (4)
  - Guildford Road / Garratt Road (3)
  - Guildford Road / First Avenue (2)
  - Guildford Road / Caledonian Avenue (2)
  - Collier Road / Beechboro Road South (3)
  - Collier Road / Crimea Street (3)
  - Collier Road / Walter Road West (2)
  - Morley Drive / McGilvray Avenue (2).

The majority of mid-block crashes have typically occurred at random locations due to reversing out of driveways or vehicles not giving way when turning. It is also noted that give-way crashes were recorded on Russell Street between Rudloc Road and the school crossing just south of Catherine Street. One of these crashes involved a pedestrian at the school crossing. There have also been a number of crashes involving pedestrian and/or cyclist.

- There are nine locations within the City which have had multiple crashes involving pedestrians and/or cyclists. These include:
  - Morley Drive / McGilvray Avenue (3 cyclists)
  - Russell Street between Walter Road West and Broun Avenue (10 pedestrians, 2 cyclists)
  - Caledonian Avenue between Railway Parade and Whatley Crescent, noting this is a level crossing (1 pedestrian, 4 cyclists)
  - Guildford Road / Eighth Avenue (4 pedestrians)
  - Guildford Road between Falkirk Avenue and Caledonian Avenue (4 pedestrians, 2 cycists)
  - Karrinyup Road / Crimea Street (2 pedestrians)
  - McGilvray Avenue (near Lincoln Village Shopping Centre) (2 pedestrians)
  - Beechboro Road North near Walter Road East (3 cyclists, 1 pedestrian)
  - Beechboro Road South / Railway Parade (3 cyclists)
  - Broun Avenue / McGregor Street (2 cyclists).

The occurrence of these crashes identifies that these areas are popular with cyclists and pedestrians, however the existing facilities may not be sufficient.

Table 5.2: City of Bayswater Type of Vehicles Involved in Crashes

Type of Vehicle	Number of Crashes	Percentage	EMRC Average
Bicycle	86	0.9%	0.9%
Car	8127	85.7%	84.3%
Heavy Vehicles	292	3.1%	4.6%
Motor Cycle	140	1.5%	2.2%
Pedestrian	84	0.9%	0.7%
Total (Known)	**8729**	**92.1%**	**92.6%**
Unknown	750	7.9%	7.4%

Table 5.3: City of Bayswater Midblock vs Intersection Crash

Location	Number of Crashes	Percentage	EMRC Average
Intersection	3,183	62.5%	59.7%
Midblock	1,911	37.5%	40.3%
Total	5,094	100%	100%

Table 5.4: City of Bayswater Crash Type

Location	Number of Crashes	Percentage	EMRC Average
Head On	27	0.6%	1.1%
Hit Animal	4	0.1%	0.6%
Hit Object	287	5.8%	9.2%
Hit Pedestrian	80	1.6%	1.2%
Non-Collision	42	0.9%	1.5%
Rear End	2111	43.0%	44.1%
Right Angle	1190	24.3%	22.4%
Right Turn Thru	527	10.7%	6.0%
Sideswipe Same Direction	572	11.7%	10.5%
Total (Known)	**4840**	**98.7%**	**96.4%**
Unknown	66	1.3%	3.6%

5.4. High Risk Areas

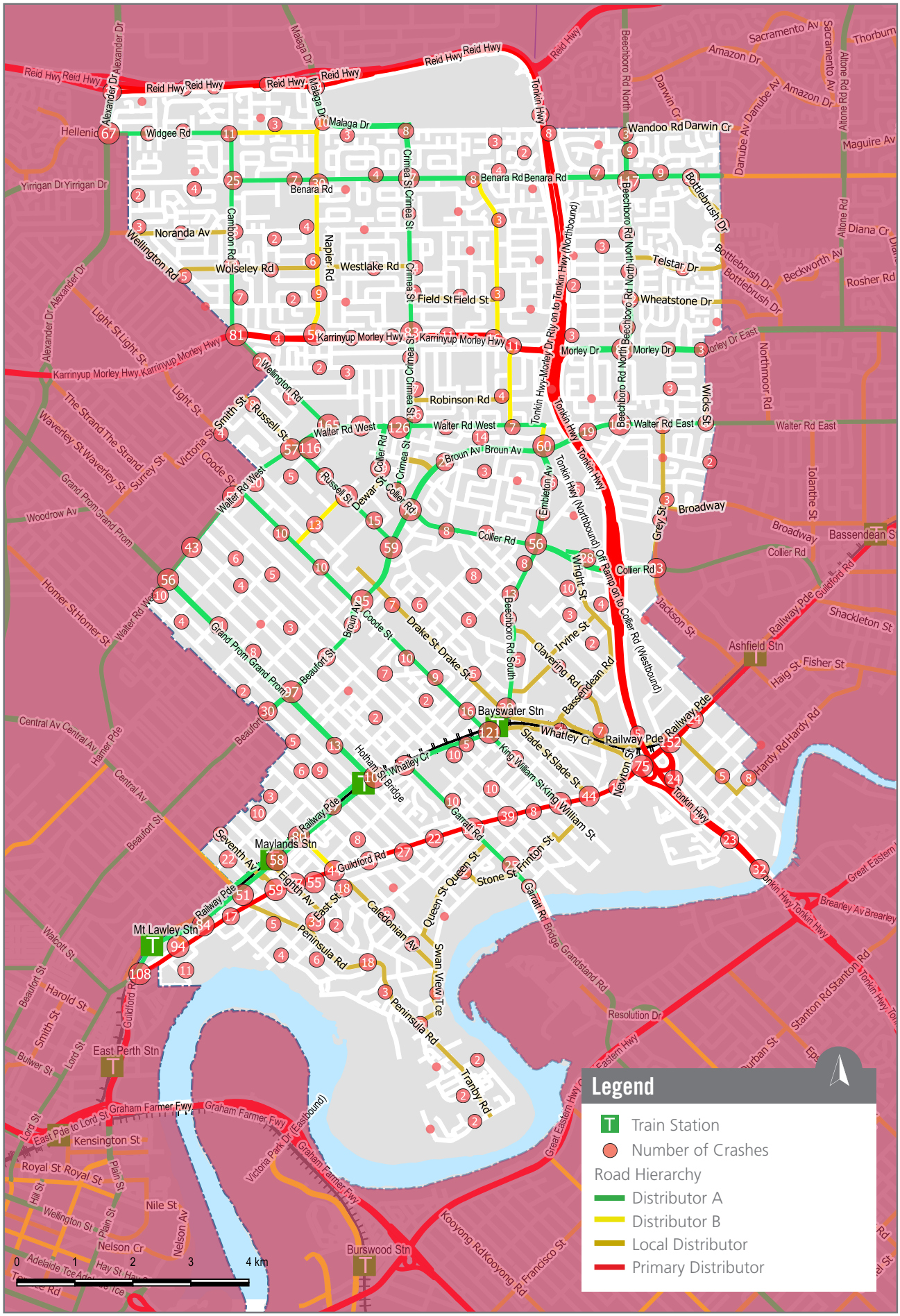
Key areas for consideration for the EMRC to advocate for a further review of within the City of Bayswater local government area include:

- Motor cycle crashes have occurred multiple times at the following locations:
  - Whatley Crescent / Hotham Street Bridge (7)
  - Guildford Road / Peninsula Road (5)
  - Guildford Road / Whatley Crescent (5)
- Consider a corridor study of:
  - The Primary Distributor and Distributor A roads of **Walter Road West, Russell Street, Broun Avenue and Beechboro Road South**.
- Further analysis of the following local intersections:
  - Sixth Avenue / Coode Street
  - King Street / Raymond Avenue
  - Sailsbury Street / Bowden Street
  - Hardey Road / Moojebing Street.

Other considerations include:

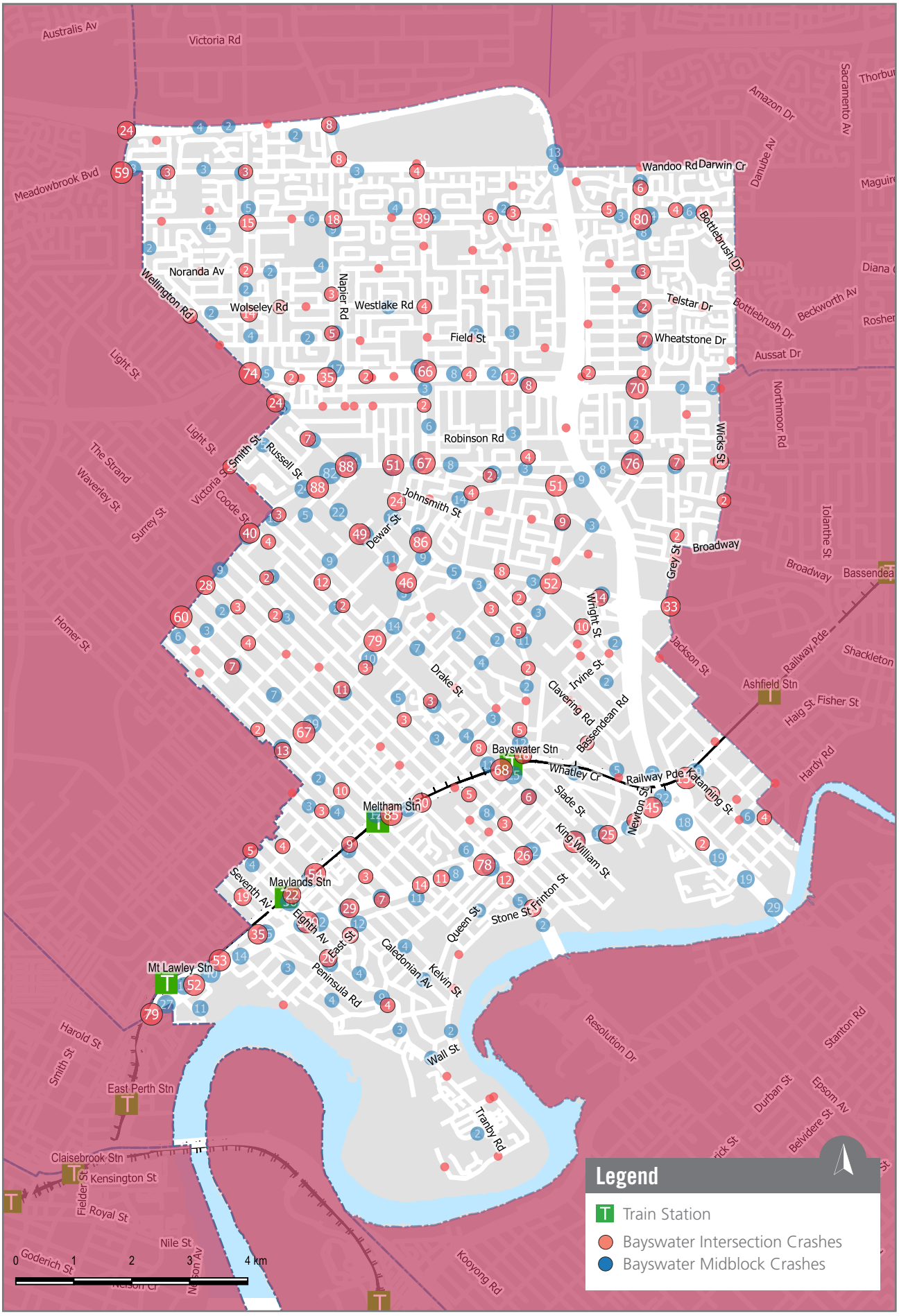
- Vulnerable Road Users – there is an at or above average crash percentage within the City of Bayswater area involving cyclists or pedestrians, respectively. Key consideration, including a review of the existing infrastructure and crossing locations should be given to the following locations:
  - Morley Drive / McGilvray Avenue (3 cyclist crashes, all requiring medical attention)
  - McGilvray Avenue (2 pedestrian crashes requiring hospitalisation, due to visual obstruction caused by parked cars)
  - Walter Road West between Light Street and Crimea Street (7 pedestrian crashes and 3 cyclist crashes)
  - Russell Street (10 pedestrian and 2 cyclist crashes) – Near Morley Galleria – a review to increase the pedestrian and cyclist environment is recommended)
  - Beaufort Street between Salisbury Street and Broun Avenue (9 cyclist crashes and 1 pedestrian crash)
  - Walter Road East near Beechboro Road North (3 cyclist crashes)
  - Beechboro Road South / Railway Parade (3 cyclist crashes)
  - King William between Broun Avenue and Georgina Street (6 pedestrian and 4 cyclists).
  - Gummery Street near the bend before Coode Street (2 cyclist crashes, 1 requiring medical attention and 1 requiring hospitalisation).
- Intersections
  - Within the City of Bayswater area, there is a higher than average percentage of crashes that occur at intersections.
  - Within the City of Bayswater area, a significantly higher percentage of right turn through crashes are noted, and further review should be undertaken to identify if signals or signage should be amended.

Figure 5.1: Overall Number of Crashes within the Local Government Area



Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 5.2: Overall Midblock vs Intersection Crashes within the Local Government Area

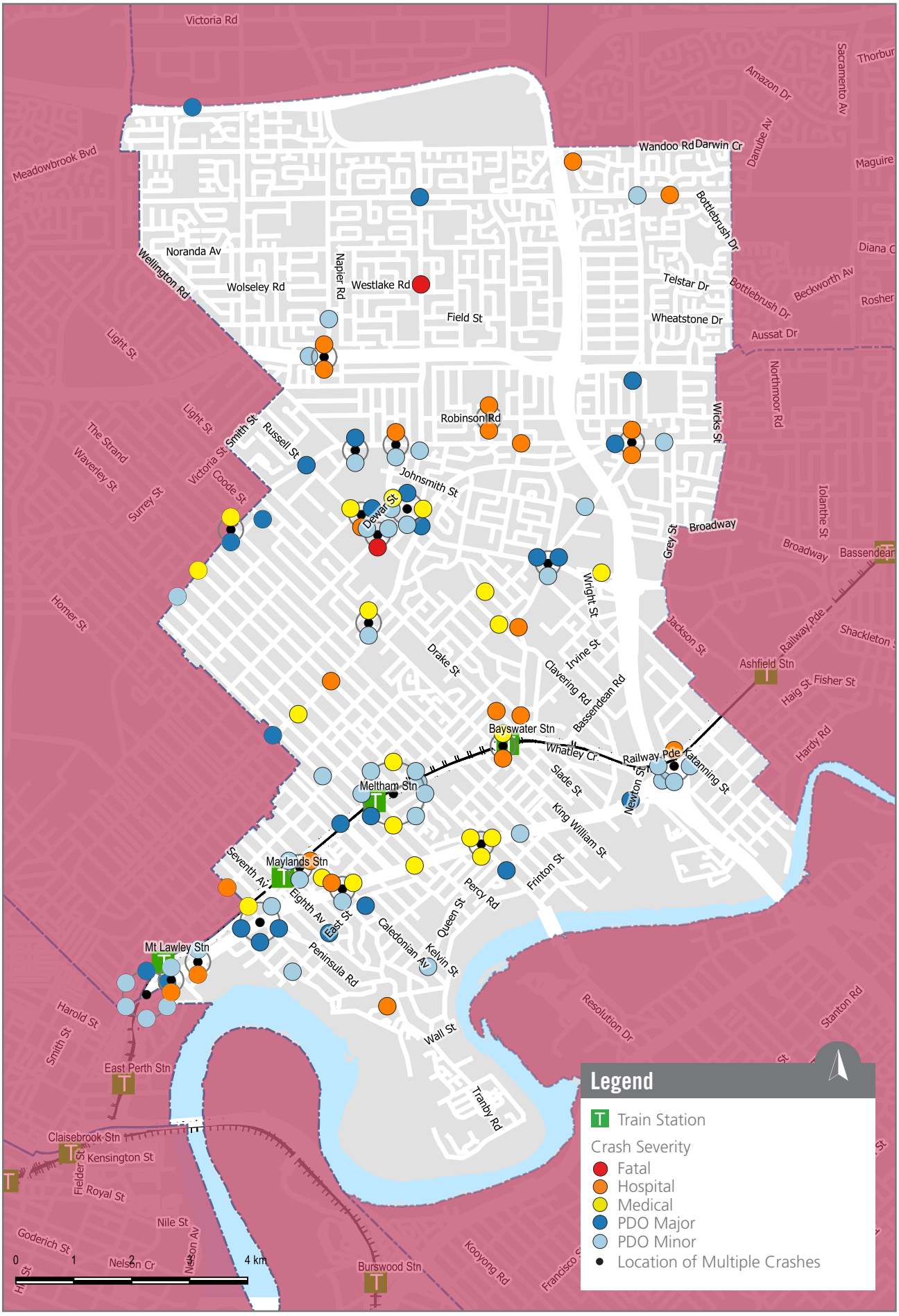


Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 5.3: Cyclist and Pedestrian Crashes within the Local Government Area

Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 5.4: Motor cycle Crashes within the Local Government Area



Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

6. City of Belmont Road Safety Review

6.1. Background

The City of Belmont has a land area of approximately 40km^2 with an estimated resident population (ERP) of 41,510[13] and population density of 10.46 persons per hectare. The City's population has grown steadily from 31,560 since 2006.

The City of Belmont is bound by the Swan River to the north, with the City of Bayswater and Town of Bassendean on the other side of the River, Town of Victoria Park to the south-west, City of Canning to the south-east, City of Kalamunda to the east, and City of Swan to the north-east. The City of Belmont is not serviced by a passenger train line at present; however, Redcliffe Station will be constructed as part of the State Government's METRONET. This will connect to the Midland Line and terminate at the future Forrestfield Station via Perth Airport. Major roads in the City include Tonkin Highway, Leach Highway, Great Eastern Highway and Orrong Road, all of which form a boundary around the City's residential edges.

The City has a number of distinct neighbourhoods including the Ascot Racecourse and adjacent Stables Zone, industrial areas including the Kewdale Freight Terminal, Belmont Mixed Use Zone, and residential areas. The Belmont Town Centre was also recoded in December 2011, which has seen an increase in apartments (Multiple Dwellings) and Grouped Dwellings in the area.

The MRWA crash data for the period between 2013 to 2017 recorded a total of 5,091 crashes involving 10,087 units (including cars, buses, trucks, pedestrians and cyclists). Of the total number of crashes, 6 (0.1%) were fatal, 157 (3.1%) required hospitalisation and 630 (12.4%) required medical attention. Two of the fatal crashes involved pedestrians (inclusive of the use of a manual recreational scooter), which highlights the importance of protecting vulnerable road users.

6.2. Literature Review

City of Belmont – Belmont on the Move 2015

The Integrated Transport Strategy for Belmont (Belmont on the Move) is a holistic study assessing all modes as well as community needs. While there is no specific section or analysis around road safety within the Strategy, recommendations do include such things as reduce speed zones (40km/h zones), improved pedestrian and cycle infrastructure, improvements to bus infrastructure as well as addressing road infrastructure and on-street parking. Implementation is proposed over a number of years, as funding is available.

Population
41,510

Land Area
40km^2

Density
10.46
persons per hectare

13 Population Estimate from ProfileID, derived from the Australian Bureau of Statistics Estimated Residential Population 2018

Table 6.1: City of Belmont Crash Severity

Severity	Number of Crashes	Percentage	EMRC Average
Fatal	6	0.1%	0.3%
Hospital	157	3.1%	4.6%
Medical	630	12.4%	13.6%
PDO Major	2698	53.0%	53.4%
PDO Minor	1600	31.4%	28.0%
Total	**5,091**	**100%**	**100%**

City of Belmont – Draft Sustainable Transport Plan 2019

The Sustainable Transport Plan is intended to create real change towards a more sustainable transport network for the people within the City of Belmont. The Plan, updates and combines the City's most recent TravelSmart Plan and Local Bike Plan into one document, together with a walking plan and a high level overview of public transport; a four-in-one plan whose outcomes have been informed by community consultation, documentation review and further analysis of the transport network. The plan aligns with the sustainable transport objectives set out in Belmont on the Move, for the City to be pedestrian and cyclist-friendly, traffic-calmed and accessible, and supporting sustainable transport with good public transport. In addition to active and public transport infrastructure recommendations, the plan identifies a number of reduced speed measures and a number of behaviours change recommendations, addressing safer roads, safer speeds and safer road use.

6.3. Crash Hotspots

5,092 crashes were recorded within the City of Belmont area between 1 January 2013 and 31 December 2017, which involved 8,754 known units, which include bicycles, cars, heavy vehicles (including buses, trucks, semitrailers, tractors and road trains), motor cycles (including motorised scooters) and pedestrians (including motorised wheelchairs, skateboards and manual scooters). It is noted that the vehicle type data for 1,064 vehicles were not recorded. 81.8% of crashes involved cars, whilst 3% included vulnerable road users including bicycles, motor cycles and pedestrians. 4.4% of crashes involved heavy vehicles, which is slightly less than the EMRC area average of 4.6%. The majority of crashes within the City of Belmont occurred at intersections (64.8%), which is more than the EMRC area average. The City of Belmont has a rich mixture of urban (including low to high density residential areas) and industrial land uses, which is reflected in the mix of crashes.

The crash data maps identify a few features within the City of Belmont area. These are summarised below:

- A large proportion of crashes occurred on higher order roads, such as Great Eastern Highway (Primary Distributor), Tonkin Highway(Primary Distributor), Leach Highway(Primary Distributor), Orrong Road (Primary Distributor), Abernethy Road (Distributor A), Garratt Road (Distributor A), Belgravia Street (Distributor A to Frederick Street, Local Road to Gabriel Street and Local Distributor to Kew Street).

However, a number of crashes have also occurred on all of the Distributor B and Local Distributor roads. Distributor B roads include Hardey Road, and Alexander Road, whilst Local Distributors include Francisco Street, Wright Street, Oats Street, Acton Avenue, Epsom Avenue, Belvidere Street, Frederick Street, Belgravia Street, Kew Street and Stanton Road.

Of these, Tonkin Highway, Leach Highway, Great Eastern Highway, Graham Farmer Freeway are Primary Regional Roads whilst Belgravia Street (between Fairbrother and Great Eastern Highway), Fairbrother Street (between Abernethy Road and Belgravia Street), Abernethy Road (between Fairbrother Street and Tonkin Highway), Kewdale Road and Orrong Road, are Other Regional Roads, as defined under the Metropolitan Region Scheme. Therefore, these roads are under the control of MRWA or the Department of Planning, Lands and Heritage, respectively, with some functions potentially delegated to the local government. The analysis does not focus on these roads, but rather focusses on other lower order local roads.

There are also a high frequency of crashes along local roads. This may be due to the City's grid form and built out nature. It is noted there is a higher number of crashes along routes which allow through movement throughout the City. The majority of crashes on local roads are midblock crashes.

- Local road intersections which have recorded a high number of crashes include:
  - Francisco Street / Gladstone Road (16)
  - Kooyong Road / Newey Street (8)
  - Kooyong Road / Campbell Street (6)
  - Fulham Street / Armadale Road (7)
  - Fulham Street / Acton Avenue (5)
  - Fulham Street / Belmont Avenue (18)
  - Fulham Street / Fisher Street (10)
  - Durban Street / Leake Street (7)
  - Epsom Avenue / Victoria Street (6)
  - Acton Avenue / Francisco Street (7)
  - Belmont Avenue / Francisco Street (20)
  - Hardey Road / Alexander Drive (15)
  - Hardey Road / Sydenham Street (10)
  - Hardey Road / Gabriel Street (11)
  - Gabriel Street / Fisher Street (11).
- A large number of crashes have also occurred within the Perth Airport area, where the roads are subject to federal legislation outside the control of the Western Australian State Government and Local Government. Key roads include Horrie Miller Drive and Grogan Road. It should be noted that large infrastructure works have been undertaken within this vicinity and these crash statistics are not reflective of the current road network.
- Whilst the percentage of heavy vehicle crashes is below the EMRC area average, the City of Belmont has the third highest percentage of heavy vehicle crashes in Perth's eastern region. The majority of heavy vehicle crashes have occurred along Great Eastern Highway, Abernethy Road (with a higher concentration in the Kewdale Industrial Area), Kewdale Road, Leach Highway, Tonkin Highway and Orrong Road, all of which are higher order roads (Primary Distributor or Distributor A). Local roads which have a multiple occurrence of heavy vehicle crashes include:
  - Hardey Road / Alexander Road (2)
  - Abernethy Road at or near Francisco Street, within the Belmont Mixed Use Zone (3)
  - Belmont Avenue / Campbell Street (2).

It should be noted that heavy vehicles include buses and therefore a proportion of the heavy vehicle crashes in residential areas involve a bus.

- A number of cyclist and pedestrian crashes also occurred in the area, with key areas identified as follows:
  - Belmont Avenue, particularly between Wright Street and Gabriel Street (5 cyclists and 4 pedestrians, noting this is near Belmont Forum, which is an attractor)
  - Belmont Avenue / Campbell Street (2 cyclists)
  - Armadale Road / Alexander Road (3 cyclists with two requiring medical attention or hospitalisation)
  - Grandstand Road between Raconteur Drive and Waterway Crescent (3 cyclists with two requiring medical attention or hospitalisation)
  - Great Eastern Highway at Abernethy Road and Belgravia Street intersections have also experienced a high number of crashes involving cyclists and pedestrians.
- The majority of motor cycle crashes have occurred along Orrong Road, with the intersections with Francisco Street, Roberts Road (Town of Victoria Park), Alexander Road, Archer Street (Town of Victoria Park), Wright Street, Oats Street, Briggs Street and Leach Highway, all having multiple crash occurrences. Key hotspots along Great Eastern Highway include the intersections of Epsom Avenue, Tonkin Highway, Coolgardie Street and Fauntleroy Avenue. Six crashes also occurred at the intersection of Horrie Miller Drive and Tonkin Highway, between the City of Belmont and Perth Airport,
- Local roads with multiple motor cycle crashes include:
  - Alexander Road / Kooyong Road (2)
  - Wright Street / Armadale Road (2)
  - Wright Street / Belmont Avenue (2)
  - Gabriel Street / Hardey Road (2)
  - Keane Street / Trink Street (2).
- There is a higher proportion of rear end, right turn through and sideswipe same direction crashes within the City of Belmont area than the EMRC area average. This can be an indication of congestion, where vehicles do not react in time and therefore result in rear end crashes or vehicles attempt to overtake which would see sideswipe same direction type crashes. The higher proportion of right turn through traffic may be an indicator of the existing signals in place, such as traffic signals which allow filtered right turn movements or stop or give-way signs. The City of Belmont also have a high number of roundabouts which may result in more rear-end crashes. However, reduces the number of right angle crashes and severity of crashes as drivers are required to slow upon approach.

Table 6.2: City of Belmont Type of Vehicles Involved in Crashes

Severity	Number of Crashes	Percentage	EMRC Average
Bicycle	79	0.8%	0.9%
Car	8030	81.8%	84.3%
Heavy Vehicles	430	4.4%	4.6%
Motor Cycle	173	1.8%	2.2%
Pedestrian	42	0.4%	0.7%
Total (Known)	**8754**	**89.2%**	**92.6%**
Unknown	1064	10.8%	7.4%

Table 6.3: City of Belmont Midblock vs Intersection Crash

Location	Number of Crashes	Percentage	EMRC Average
Intersection	3,301	64.8%	59.7%
Midblock	1790	35.2%	40.3%
Total	**5,091**	**100%**	**100%**

Table 6.4: City of Belmont Crash Type

Location	Number of Crashes	Percentage	EMRC Average
Head On	18	0.4%	1.1%
Hit Animal	4	0.1%	0.6%
Hit Object	254	5.0%	9.2%
Hit Pedestrian	40	0.8%	1.2%
Non-Collision	40	0.8%	1.5%
Rear End	2595	51.0%	44.1%
Right Angle	983	19.3%	22.4%
Right Turn Through	317	6.2%	6.0%
Sideswipe Same Direction	617	12.1%	10.5%
Total (Known)	**4868**	**95.6%**	**96.4%**
Unknown	223	4.4%	3.6%

6.4. High Risk Areas

The City of Belmont has a grid block layout throughout much of the City. This has resulted in an accessible network. However, through routes have also been identified to have a higher frequency of crashes. The majority of crashes on local roads occur at intersections.

The following local roads of particular concern are:

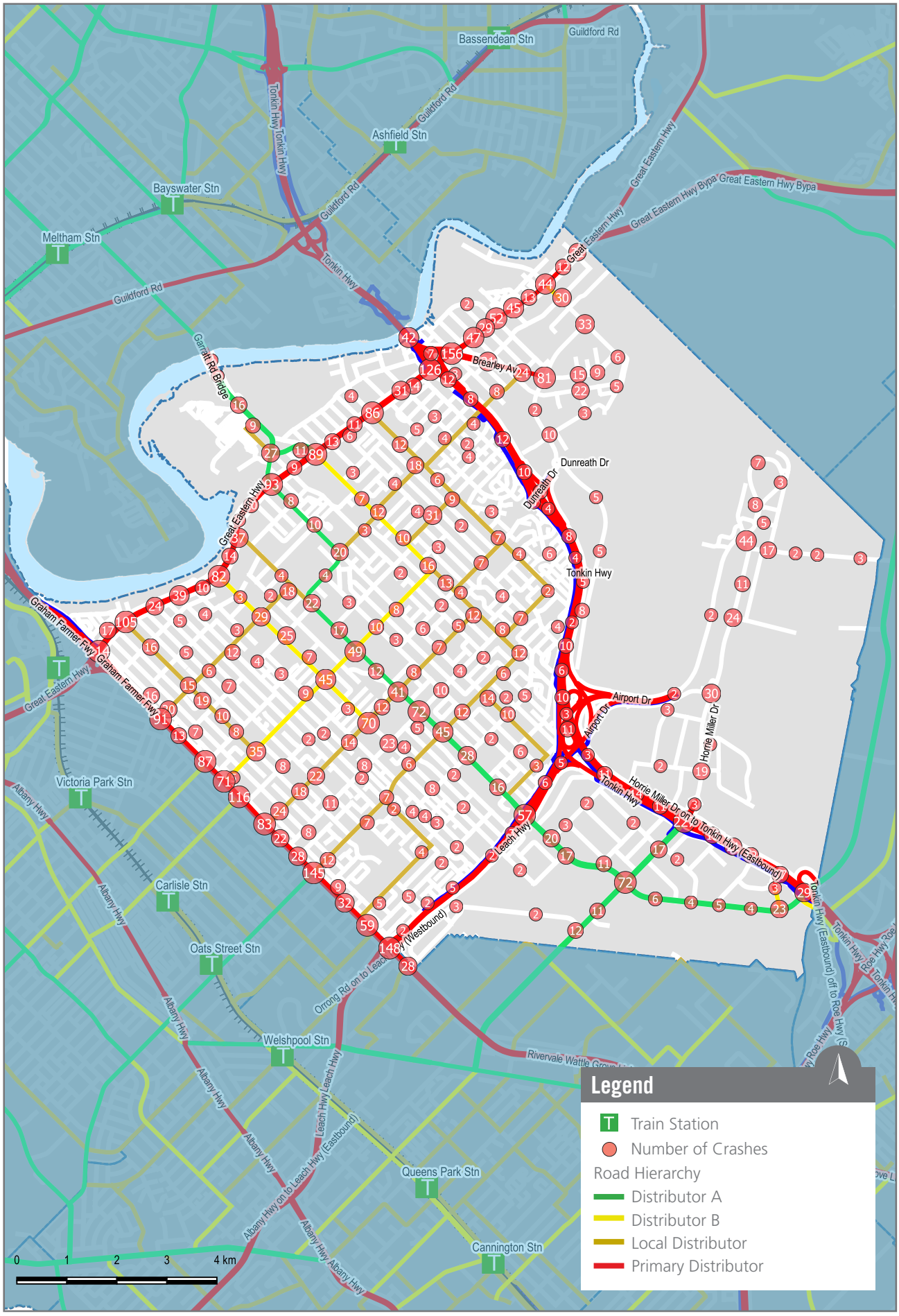
- Keane Street
- Sydenham Street
- Campbell Street
- Surrey Road
- Daly Street
- Keymer Street
- Miles Road
- Fulham Street (with 20 midblock crashes between Robinson Street and Abernethy Road).

- Local road intersections which have recorded a high number of crashes include:
  - Francisco Street / Gladstone Road (16)
  - Francisco street / Action Avenue (7)
  - Kooyong Road / Newey Street (8)
  - Kooyong Road / Campbell Street (6)
  - Fulham Street / Armadale Road (7)
  - Fulham Street / Acton Avenue (5)
  - Fulham Street / Belmont Avenue (18)
  - Fulham Street / Fisher Street (10)
  - Durban Street / Leake Street (7)
  - Epsom Avenue / Victoria Street (6)
  - Hardey Road / Alexander Drive (15)
  - Hardey Road / Sydenham Street (10)
  - Hardey Road / Gabriel Street (11).

These intersections are generally along the same routes, and therefore corridor studies of these roads **(Francisco Street, Kooyong Road, Fulham Street and Hardey Road**) could be considered.

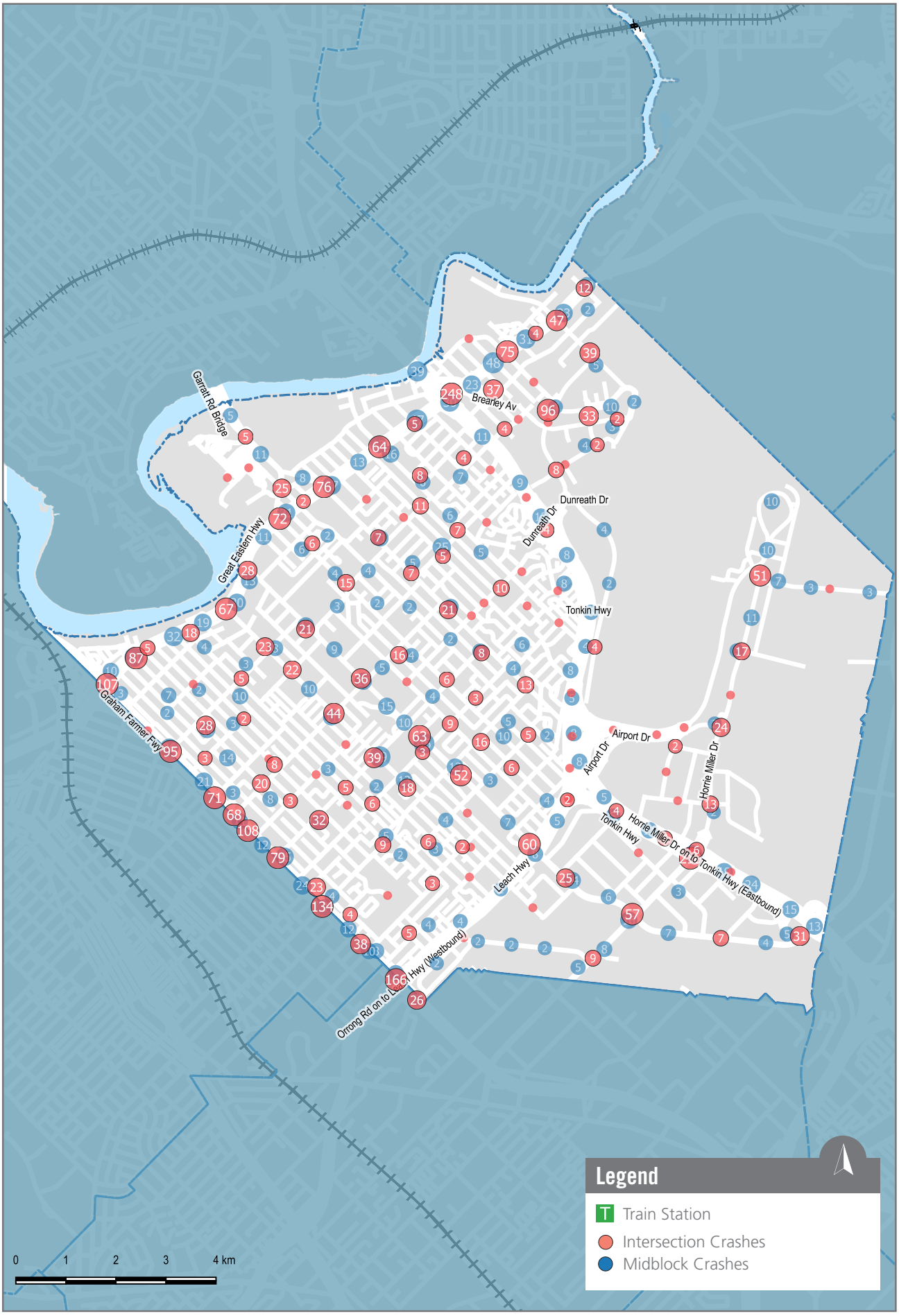
- Types of crashes - There is a higher instance of rear end crashes, right angle crashes and sideswipe same direction crashes within the City of Belmont area, which could be analysed in further detail.

Figure 6.1: Overall Number of Crashes within the Local Government Area



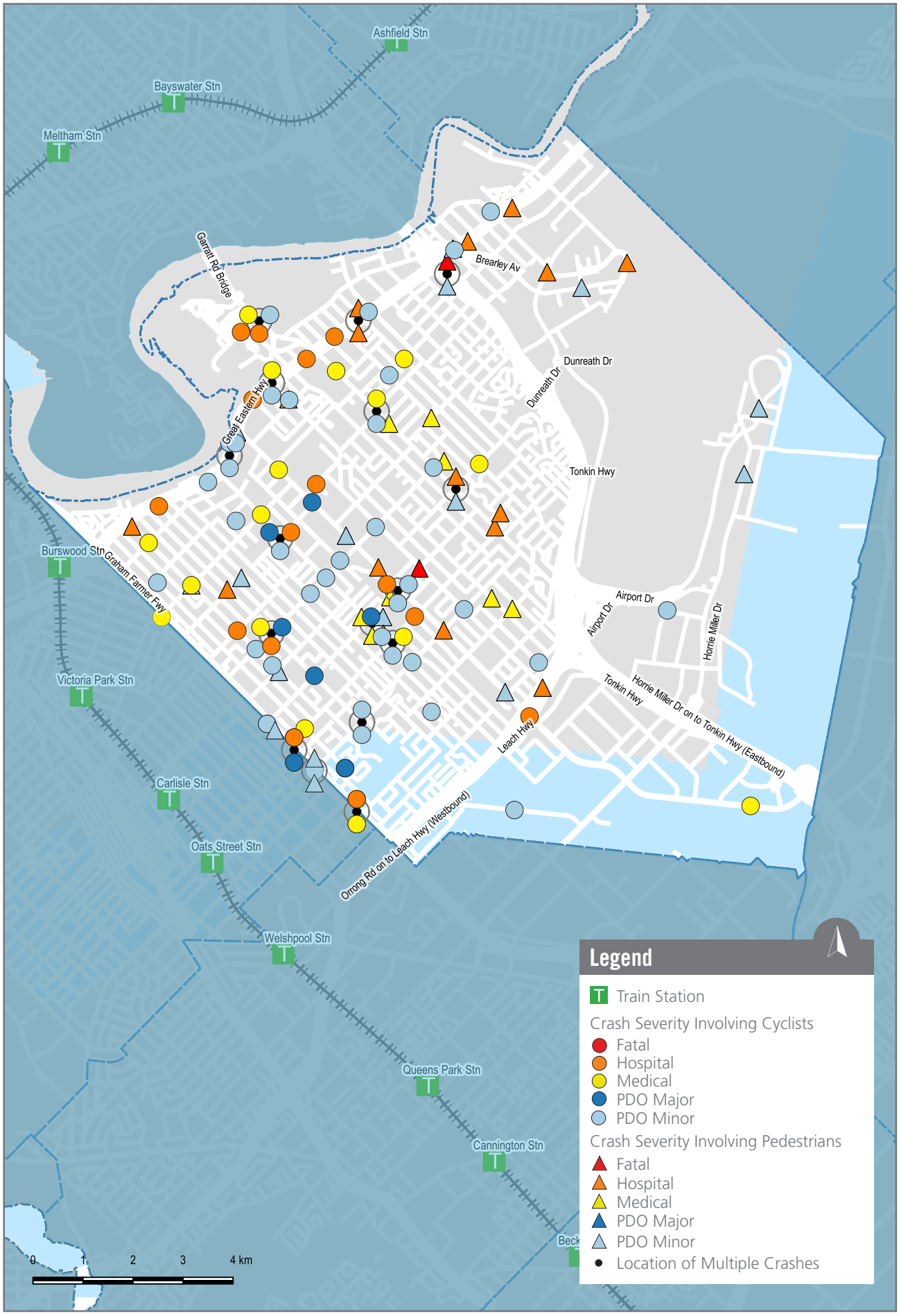
Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 6.2: Overall Midblock vs Intersection Crashes within the Local Government Area



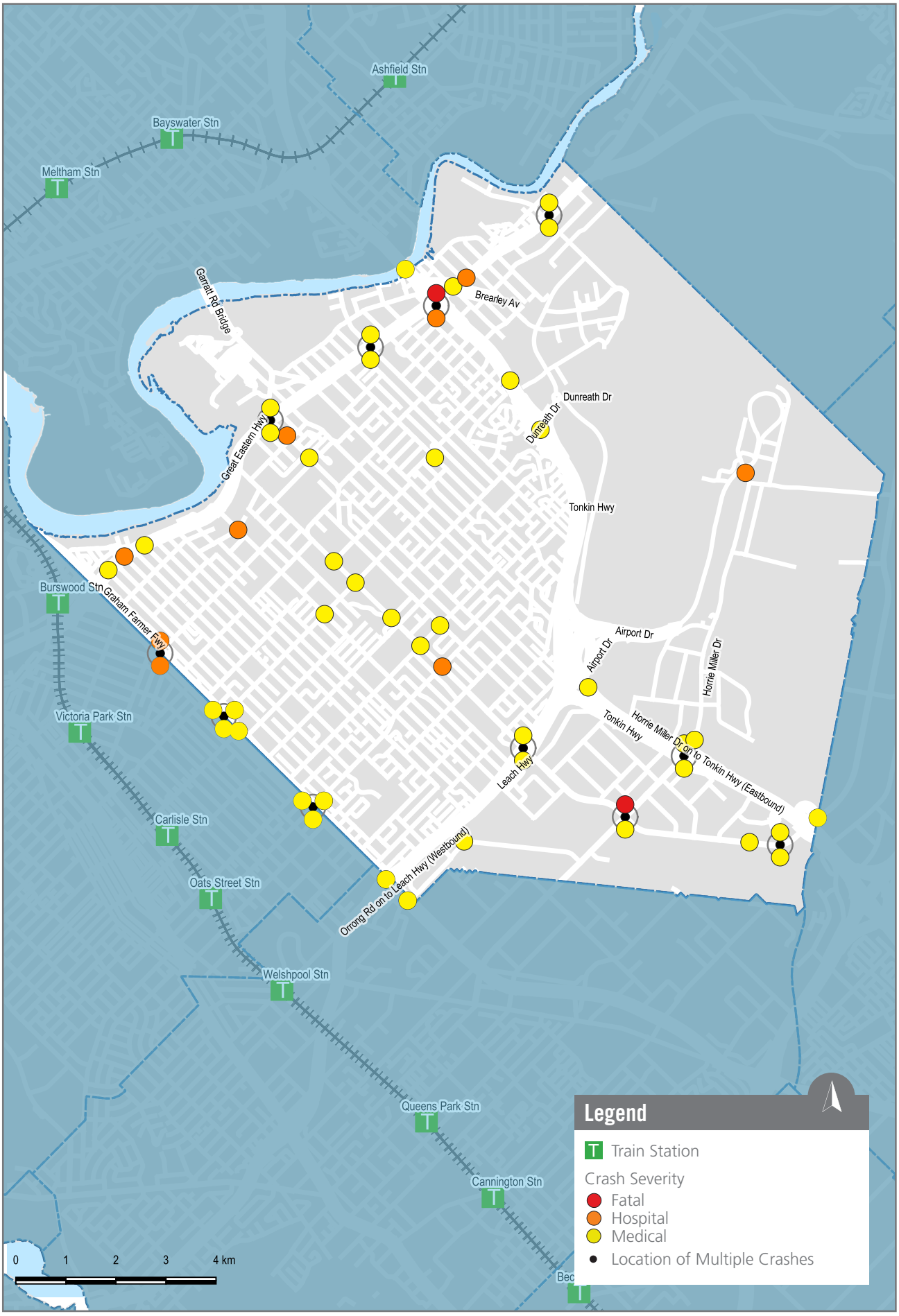
Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 6.3: Cyclist and Pedestrian Crashes within the Local Government Area



Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 6.4: Killed and Seriously Injured Bus and Heavy Vehicle Crashes within the Local Government Area



Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

7. City of Kalamunda Road Safety Review

7.1. Background

The City of Kalamunda has a land area of approximately 324km^2 with an ERP of 58,946[14] and a population density of 1.82 persons per hectare. Although the City has experienced an overall growth from 51,423 to 58,946 between 2006 and 2018, the population has fluctuated over the years, with a reduction in 2016 which remained quite consistent in 2017 and a further reduction in 2018.

The key transport network in the City of Kalamunda include Tonkin Highway and Roe Highway. There is currently no passenger rail servicing the City. However, Forrestfield Station, as part of the State Government's METRONET will terminate within the City's boundaries, and feed into the Midland Line. Other key road infrastructure within the City of Kalamunda include the Forrestfield Transit Orientated Development and Abernethy Road extension to Lloyd Street, the grade separation of Great Eastern Highway Bypass / Roe Highway and removal of the full movement intersection to and from Hale Road and Tonkin Highway as part of the flyover proposal. The Roe Highway / Kalamunda Road Interchange Project is also due to commence soon. It should be noted that the majority of these key routes including Tonkin Highway, Roe Highway, Great Eastern Highway and Welshpool Road East are managed by Main Roads Western Australia, and therefore out of the control of the local government.

The City is largely residential and rural with a number of key industrial areas with Restricted Access Vehicle (RAV) routes with a large portion of the City being National Parks. The urban areas of the City are rapidly growing, including High Wycombe, Maida Vale and Wattle Grove. Key industrial areas include the Hazelmere Industrial area and the Forrestfield Intermodal Terminal, which are both attractors of heavy vehicles. Key local industries include orchards, intensive horticulture activities, grazing, animal agistment, minor sawmills, poultry, Government Works Depot and the C.B.H state grain terminal[15].

The MRWA crash data for the period between 2013 to 2017 recorded a total of 3,150 crashes, inclusive of 480 single vehicle crashes, within the City of Kalamunda. Of these crashes, 18.7% required medical attention, hospitalisation or were fatal. Of the 16 fatal crashes, four involved pedestrians and nine involved motor cycles. Eight of the fatal crashes were also single vehicle crashes, where the driver lost control of the vehicle. One of these was a cyclist and four of these motorcyclists.

Population
58,946

Land Area
342km^2

Density
1.82
persons per hectare

14 Population Estimate from ProfileID, derived from the Australian Bureau of Statistics Estimated Residential Population 2018

15 City of Kalamunda History 2018 http://www.kalamunda.wa.gov.au/About-Us/Our-City/History

Table 7.1: City of Kalamunda Crash Severity

Severity	Number of Crashes	Percentage	EMRC Average
Fatal	16	0.5%	0.3%
Hospital	144	4.6%	4.6%
Medical	427	13.6%	13.6%
PDO Major	1737	55.1%	53.4%
PDO Minor	826	26.2%	28.0%
Total	**3,150**	**100%**	**100%**

7.2 Literature Review

City of Kalamunda – Bicycle Plan 2017

The City has recently prepared a Bicycle Plan with a focus on behaviour change (encouragement and education) which includes school-based programmes, network planning for better and safer cycle infrastructure and infrastructure recommendations for a ten-year time frame. The plan addressed safer cycle infrastructure, with a small portion also improving safer pedestrian infrastructure (such as shared paths, improved intersection crossing etc) as well as three recommendations for Safe Active Streets (safer speeds).

7.3. Crash Hotspots

3,150 crashes were recorded within the City of Kalamunda between 1 January 2013 and 31 December 2017, which involved 5,207 known units, including bicycles, cars, heavy vehicles (including buses, trucks, semitrailers, tractors and road trains), motor cycles (including motorised scooters) and pedestrians (including motorised wheelchairs, skateboards and manual scooters).It is noted that the vehicle type data for 555 units was not recorded. Of the known units, 80.3% involved cars, whilst 4.1% included vulnerable road users such as bicycles, motor cycles and pedestrians. There is a higher percentage (6%) of heavy vehicles involved in crashes within the City of Kalamunda when compared with the EMRC area average of 4.6%. This is likely due to the industrial areas and RAV routes, including Welshpool Road East.

The majority of crashes within the City have occurred along the higher order roads including the Primary Distributor roads of Roe Highway, Tonkin Highway and Orrong Road, and Distributor A roads of Kalamunda Road, Canning Road, Lesmurdie Road, Welshpool Road East, Hale Road, Berkshire Road and Abernethy Road. The majority of these roads being owned and managed by MRWA. However, a number of crashes have also occurred on lower order local roads:

- Berkshire Road / Dundas Road (8)
- Sheffield Road / Hale Road (13)
- Hale Road between Sheffield Road and Arthur Road, including the Sheffield Road / Hale Road intersection (26)
- Canning Road / Grove Road (8)
- Canning Road / Pomeroy Road (5)
- Maida Vale Road (35 crashes plus 34 crashes at the Roe Highway on/off ramps)
- Newburn Road (29 crashes plus 47 at the intersection of Kalamunda Road)
- Railway Road / Mead Street (5)
- Railway Road / Elizabeth Street (8)
- Gooseberry Hill Road / Williams Street (9)
- Ridge Hill Road (25)
- Mundaring Weir Road (22).

Of the above, Canning Road (between Pomeroy Road to Welshpool Road East), Maida Vale Road / Roe Highway, Railway Road / Elizabeth Street and Mundaring Weir Road have received Black Spot Program funding recently. Additionally, Berkshire Road / Dundas Road is being upgraded for RAV 7 access.

- It is noted that the majority of midblock crashes have occurred on higher order roads, including Primary Distributors, Distributor A and Distributor B roads.
- The majority of crashes on local roads occurred at intersections. The majority of crashes in rural, less built up areas also occurred at intersections.
- Whilst the percentage of cyclist and pedestrian crashes is lower than the EMRC area average, there have still been a number of notable casualty crashes in dense areas such as the Kalamunda Town Centre, Hawaiian's Forrestfield Shopping Centre and two schools (Hillside Christian College and Heritage College).
- A number of motor cycle related crashes have occurred on Tonkin Highway and Roe Highway. However, there have also been a number along Kalamunda Road, Canning Road, Mundaring Weir Road and Lesmurdie Road.
- There is a higher percentage of rear end, head on and non-collision crashes as well as those hitting objects. The higher proportion of head on and non-collision crashes as well as hitting objects may be a reflection of the topography and rural nature of the roads, which saw the majority of these crashes a result of losing control or swerving to avoid an animal or vehicle.
- 6.2% of crashes within the City of Kalamunda area also occurred when a driver attempted to overtake another vehicle. This triggers the potential for more driver awareness for safe overtaking.

Table 7.2: City of Kalamunda Type of Vehicles Involved in Crashes

Type of Vehicle	Number of Crashes	Percentage
Bicycle	48	0.8%
Car	4626	80.3%
Heavy Vehicles	345	6.0%
Motor Cycle	160	2.8%
Pedestrian	28	0.5%
Total (Known)	**5207**	**90.4%**
Unknown	555	9.6%

Table 7.3: City of Kalamunda Midblock vs Intersection Crash

Location	Number of Crashes	Percentage
Intersection	1,746	55.4%
Midblock	1,404	44.6%
Total	**3,150**	**100%**

Table 7.4: City of Kalamunda Crash Type

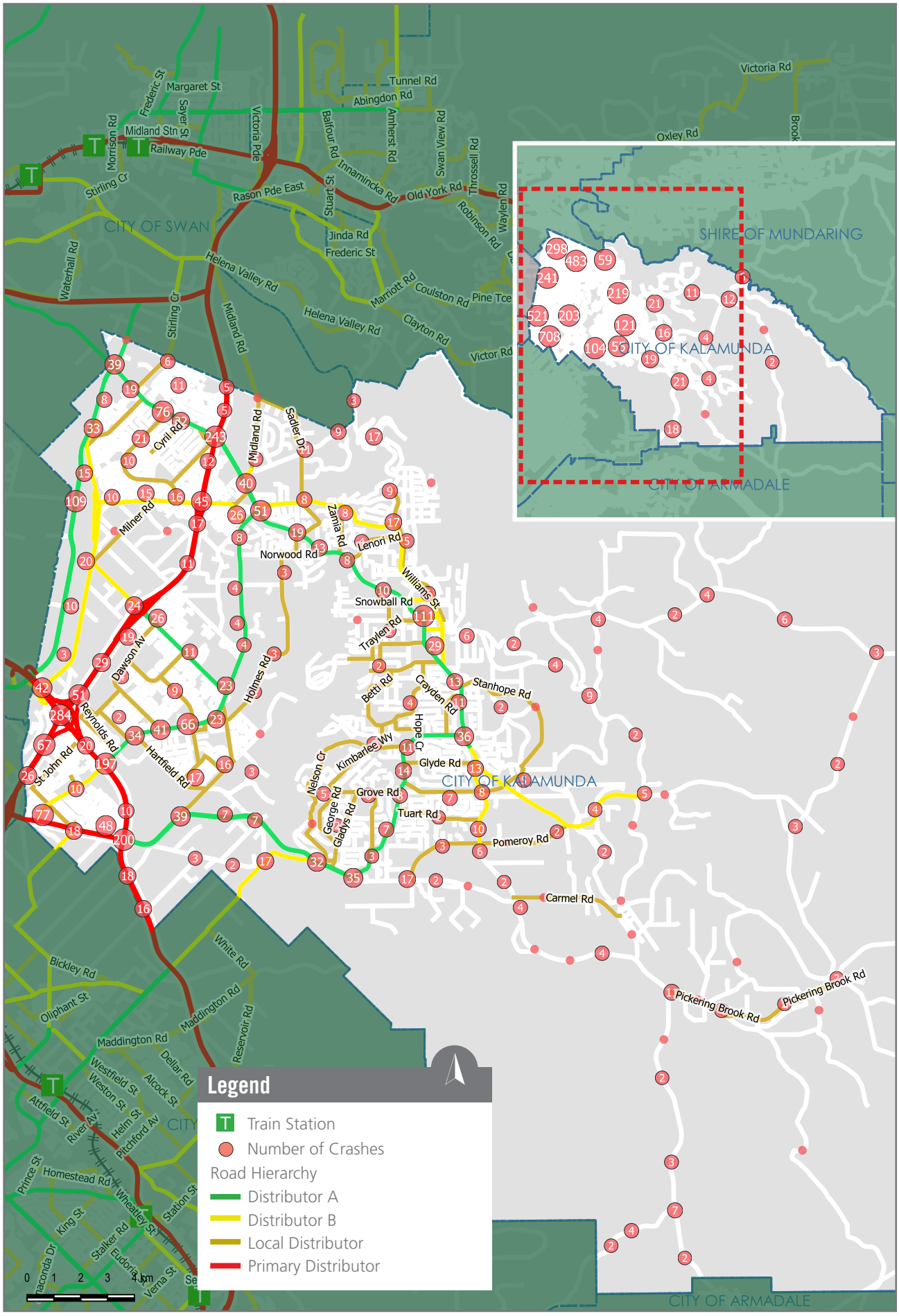
Location	Number of Crashes	Percentage
Crash Type	Number of Crashes	Percentage
Head On	53	1.7%
Hit Animal	12	0.4%
Hit Object	405	13.2%
Hit Pedestrian	28	0.9%
Non-Collision	71	2.3%
Rear End	1506	49.2%
Right Angle	519	16.9%
Right Turn Through	125	4.1%
Sideswipe Same Direction	298	9.7%
Total (Known)	**3017**	**98.5%**
Unknown	47	1.5%

7.4. High Risk Areas

The City of Kalamunda area is a unique environment and therefore faces a number of various challenges.

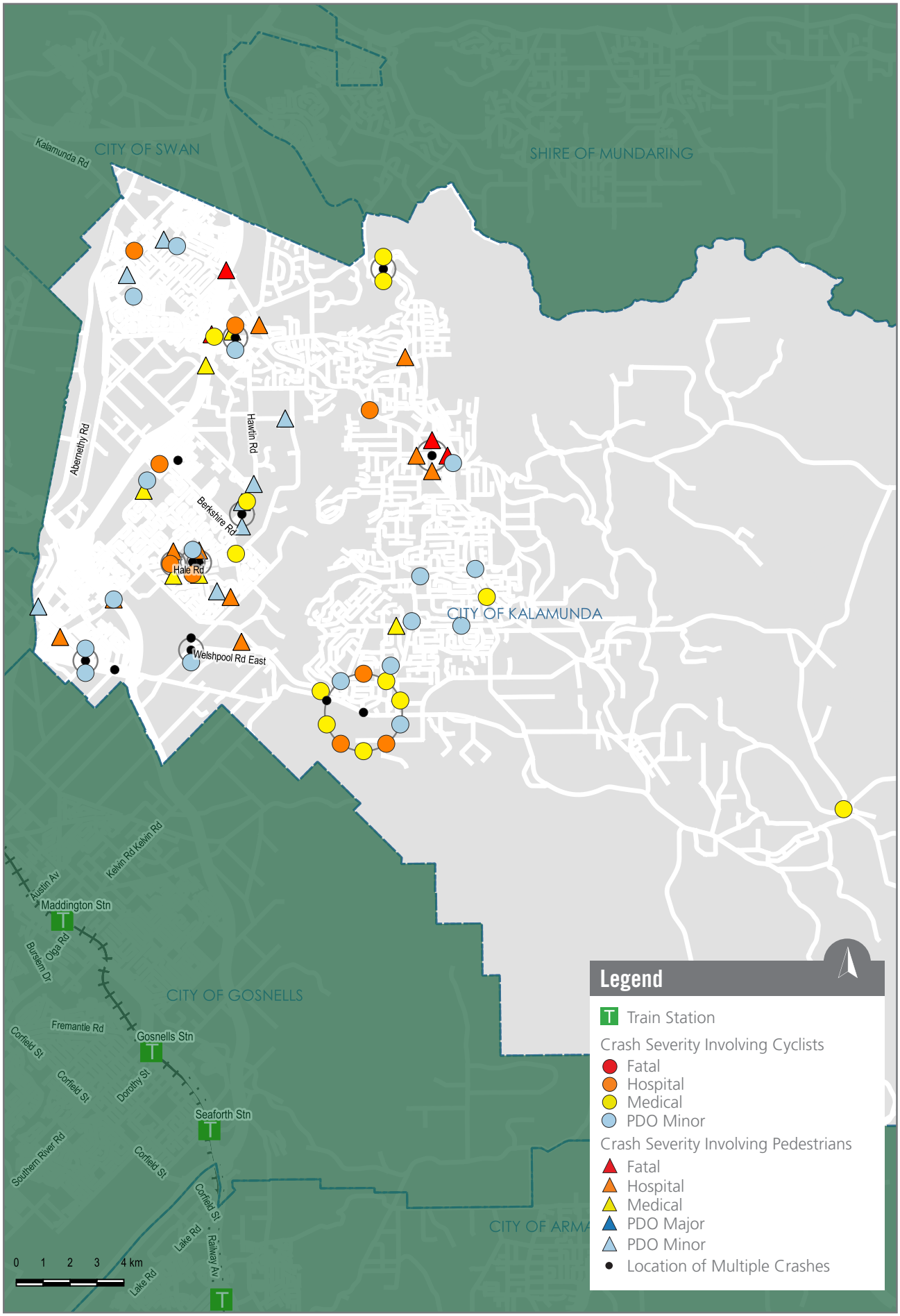
- One particular intersection of concern is the **Lesmurdie Road and Welshpool Road East** intersection which has recorded 24 crashes with 10 involving cyclists and the majority requiring medical attention or hospitalisation. The City have undertaken mitigation works to this intersection but the impact of crash reduction is still to be assessed.
- Activity areas such as shopping centres and town centres have a higher occurrence of pedestrian and cyclist related crashes.
    - Four notable pedestrian related crashes were recorded in the **Kalamunda Town Centre** on Barber Street and Heath Road, which saw two pedestrians and two cyclists involved. Two were fatal and two required hospitalisations. These all occurred as the pedestrian attempted to cross the road.
    - Two cyclist and three pedestrian related crashes occurred along Hale Road, between Dawson Avenue and Strelitzia Avenue, abutting **Hawaiian's Forrestfield**, all of which resulted in medical attention or hospitalisation.
- Driver education campaigns could be further established for safe overtaking. 6.2% of total crashes occurred in the City of Kalamunda area as vehicles attempted to overtake another vehicle. There is also a higher percentage of rear end, head on and non-collision crashes as well as those hitting objects. The higher proportion of head on and non-collision crashes as well as hitting objects may be a reflection of the topography and nature of the roads, which saw the majority of these crashes a result of losing control of the vehicle, loose gravel on the road or swerving to avoid an animal or vehicle.

Figure 7.1: Overall Number of Crashes within the Local Government Area



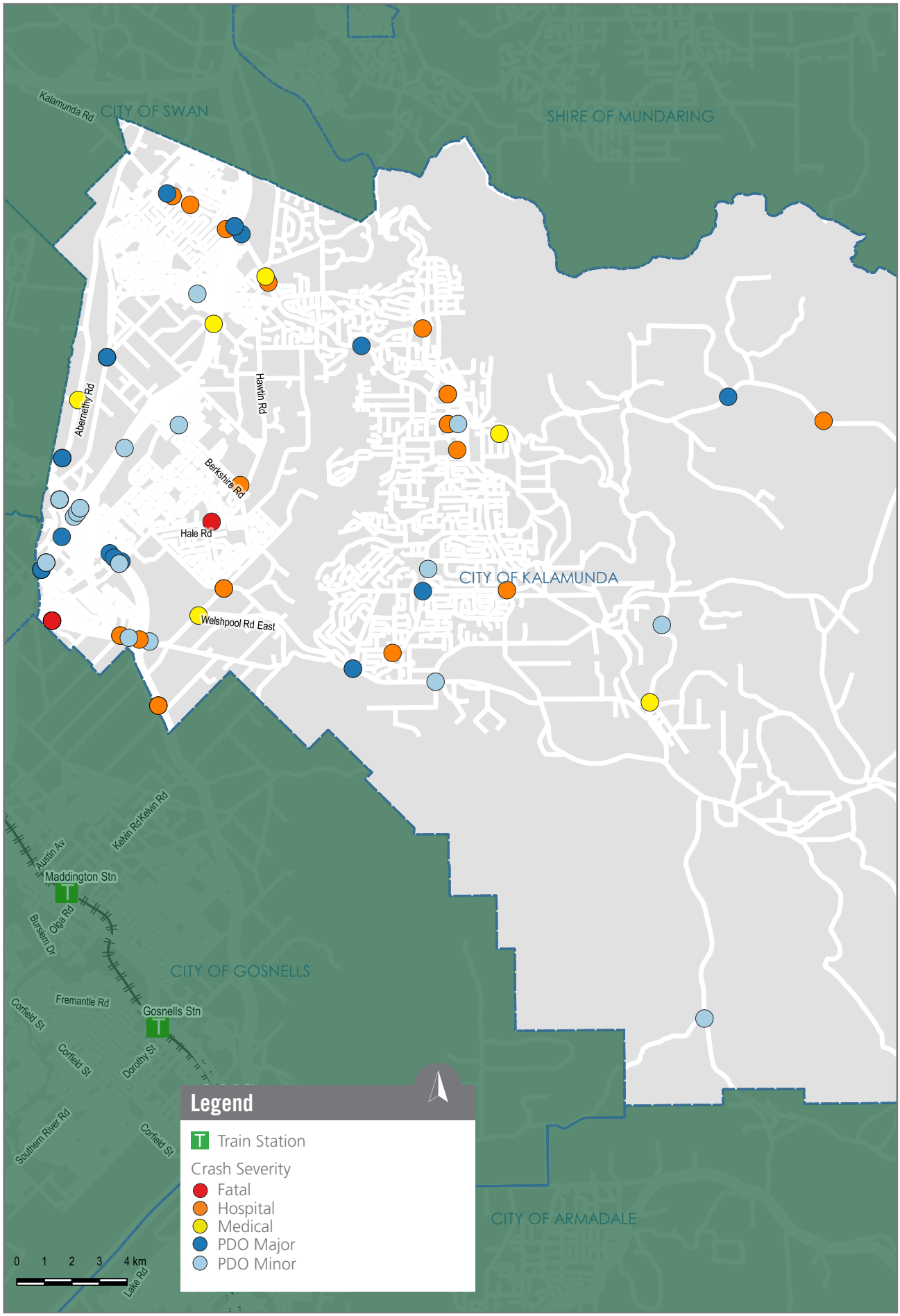
Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 7.2: Cyclist and Pedestrian Crashes within the Local Government Area



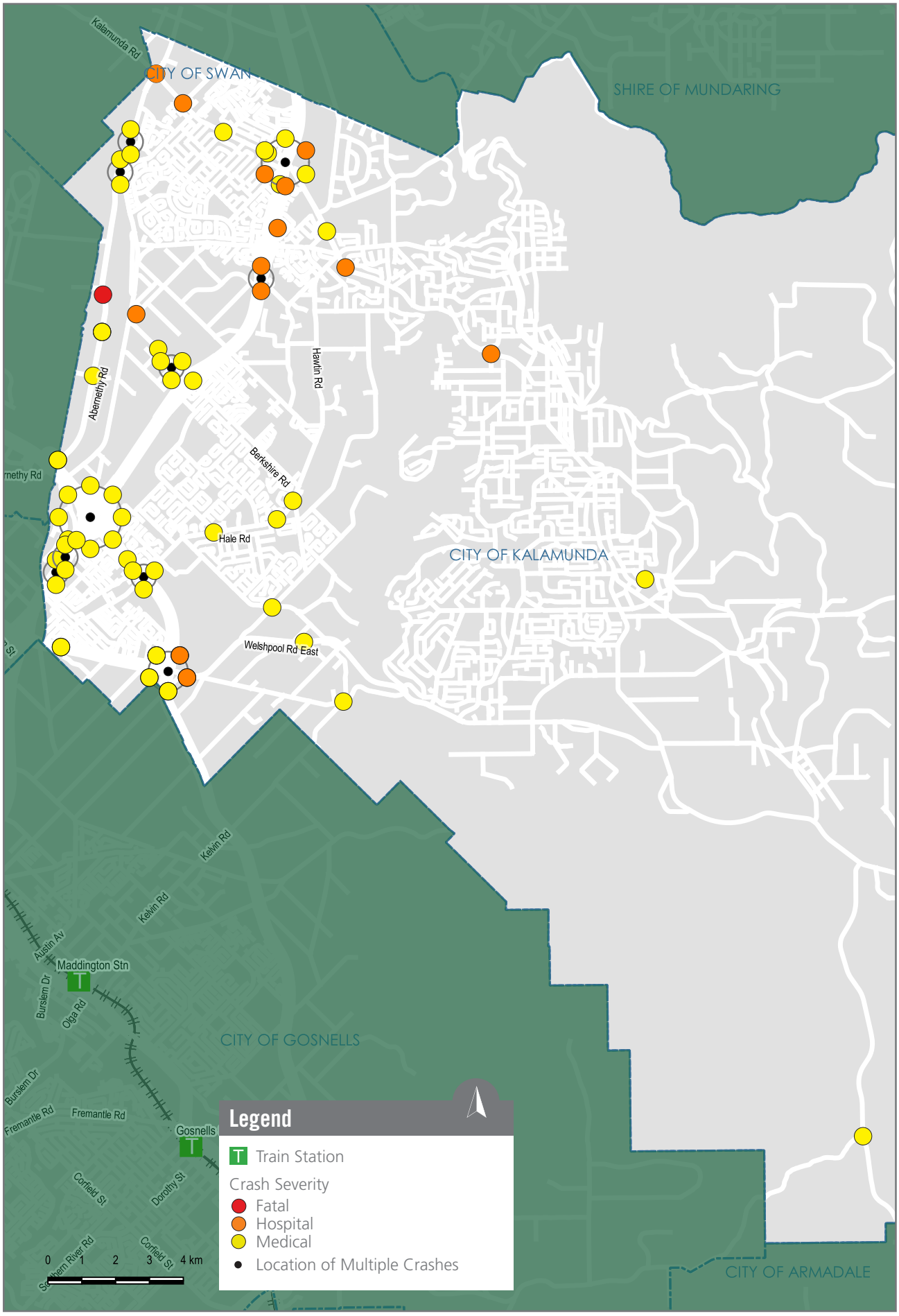
Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 7.3: Motor Cycle Crashes within the Local Government Area



Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 7.4: Killed and Seriously Injured Bus and Heavy Vehicle Crashes within the Local Government Area



Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

8. Shire of Mundaring Road Safety Review

8.1. Background

The Shire of Mundaring is the easternmost member Council with a land area of approximately 644km^2. The Shire has an ERP of 39,139[16] and a population density of 0.61 persons per hectare. Overall, the population has increased from 36,326 in 2006 to 39,139 in 2018. The Shire of Mundaring is bound by the City of Swan to the North, City of Kalamunda to the South, and Shire of Northam and York to the east. The Shire is not serviced by any passenger railway network. Key roads in the Shire include the Great Eastern Highway which is a key regional east-west link.

The MRWA CARS data for Mundaring for the period between 2013 to 2017 recorded a total of 1,813 crashes within the Shire of Mundaring. As seen in the table below there were a total of 13 fatal crashes 2 of which involved a vulnerable road user, being a motorcyclist colliding with a car when overtaking and a motorcyclist rear ending a truck. All other fatal crashes were a result of loss of control of the vehicle, with eight being single vehicle crashes.

Population
39,139

Land Area
644km^2

Density
0.61
persons per hectare

8.2. Literature Review

Shire of Mundaring – District Transport Study 2009

The District Transport Study has a focus on the Mundaring townsites comprising parts of the suburbs of Stoneville, Parkerville and Mundaring. The study discusses the importance of EastLink noting how it will improve accessibility and ultimately safety to the townsites, when regional traffic diverts to EastLink.

The study also included a crash assessment of a number of the roads and observes that Stoneville Road has the highest number of recorded crashes of the roads assessed, noting that a large proportion of the crashes occurred near the Mundaring Town Centre particularly intersection crashes. It also notes that Seaborne Street / Great Eastern Highway intersection has a relatively high record of crashes, perhaps indicating the intersection design is below standard.

8.3. Crash Hotspots

1,813 crashes were recorded within the Shire of Mundaring area which involved 2,927 known units, which include bicycles, cars, heavy vehicles (including buses, trucks, semitrailers, tractors and road trains), motor cycles (including mopeds and trail bikes) and pedestrians. It is noted that the vehicle type data for 110 units was not recorded. Of the known units, 85.8% involved cars, whilst 4.5% included vulnerable road users including bicycles, motor cycles and pedestrians. There is a higher percentage of heavy vehicles of 6.1% within the Shire of Mundaring along with a significantly higher percentage of crashes involving motor cycles in the Shire of Mundaring. This is likely due to the location and predominantly rural nature of the Shire.

16 Population Estimate from ProfileID, derived from the Australian Bureau of Statistics Estimated Residential Population 2018

Table 8.1: Shire of Mundaring Crash Severity

Severity	Number of Crashes	Percentage
Fatal	13	0.7%
Hospital	132	7.3%
Medical	244	13.5%
PDO Major	979	54.0%
PDO Minor	445	24.5%
Total	**1,813**	**100%**

Table 8.2: Shire of Mundaring Type of Vehicles Involved in Crashes

Type of Vehicle	Number of Crashes	Percentage
Bicycle	20	0.7%
Car	2,607	85.8%
Heavy Vehicles	186	6.1%
Motor Cycle	100	3.3%
Pedestrian	14	0.5%
Total (Known)	**2,927**	**96.4%**
Unknown	110	3.6%

Table 8.3: Shire of Mundaring Midblock vs Intersection Crash

Location	Number of Crashes	Percentage
Intersection	867	47.8%
Midblock	946	52.2%
Total	**1,813**	**100%**

Table 8.4: Shire of Mundaring Crash Type

Crash Type	Number of Crashes	Percentage
Head On	30	1.7%
Hit Animal	36	2.0%
Hit Object	278	15.3%
Hit Pedestrian	14	0.8%
Non-Collision	58	3.2%
Rear End	718	39.6%
Right Angle	335	18.5%
Right Turn Through	74	4.1%
Sideswipe Same Direction	181	10.0%
Total (Known)	**1,724**	**95.1%**
Unknown	89	4.9%

The crash data maps identify a few features within the Shire of Mundaring area. These are summarised below:

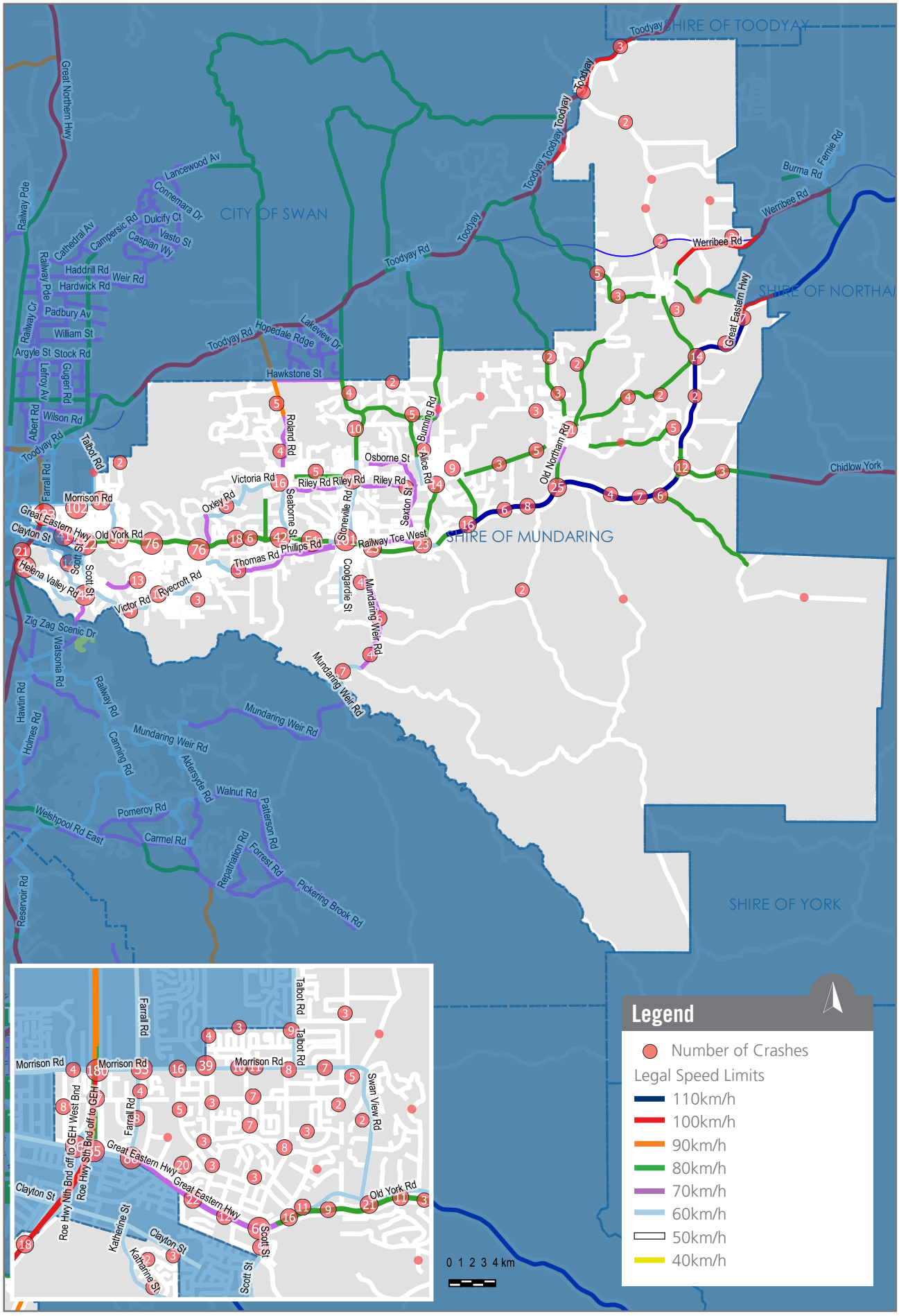
- Whilst the Shire is largely of a rural nature, the majority of crashes have occurred in busier areas including town sites and areas with a more developed footprint. This includes Swan View, Greenmount, Helena Valley, Darlington, Parkerville, Mundaring and Stoneville, with a few also in Chidlow and Wooroloo.
- There are higher percentages of crashes involving motor cycles and heavy vehicles.
- There is a higher percentage of rear end, head on and non-collision crashes as well as those hitting objects. The majority of these crashes were as a result of losing control, loose gravel on the road or swerving to avoid an animal or vehicle. All of the crashes which were non-collision crashes and those that hit an object were single vehicle crashes.
- Where speed was identified as a factor in the crash, the majority of crashes resulted in medical attention required, hospitalisation or were fatal. This further supports the need for better driver awareness.
- The majority of crashes have occurred along Primary or Regional Distributor Roads including Great Eastern Highway, Mundaring Weir Road, Stoneville Road, Sawyers Road, Riley Road, Elliot Road and Seaborne Street.
- As expected, the more urban areas have a higher incidence of crashes. Key local roads to note include:
  - Richardson Road
  - Railway Parade
  - Glen Road
  - Marlboro Road
  - Morrison Road
  - Balfour Road
  - Needham Road
  - Coppin Road.
- A high number of midblock crashes are noted on Great Eastern Highway.
- The majority of cyclist and pedestrian crashes have occurred along Morrison Road. A number of motor cycle crashes have also occurred along Morrison Road, as well as Great Eastern Highway.
- A number of motor cycle crashes have also occurred on Stoneville Road, near Richardson Road.
- The majority of heavy vehicle crashes have occurred along Great Eastern Highway and Roe Highway.

8.4. High Risk Areas

Similar to the City of Kalamunda area, the Shire of Mundaring area has a diverse range of land uses, though it is predominantly rural residential. As such the following key consideration for the EMRC to advocate for have been identified:

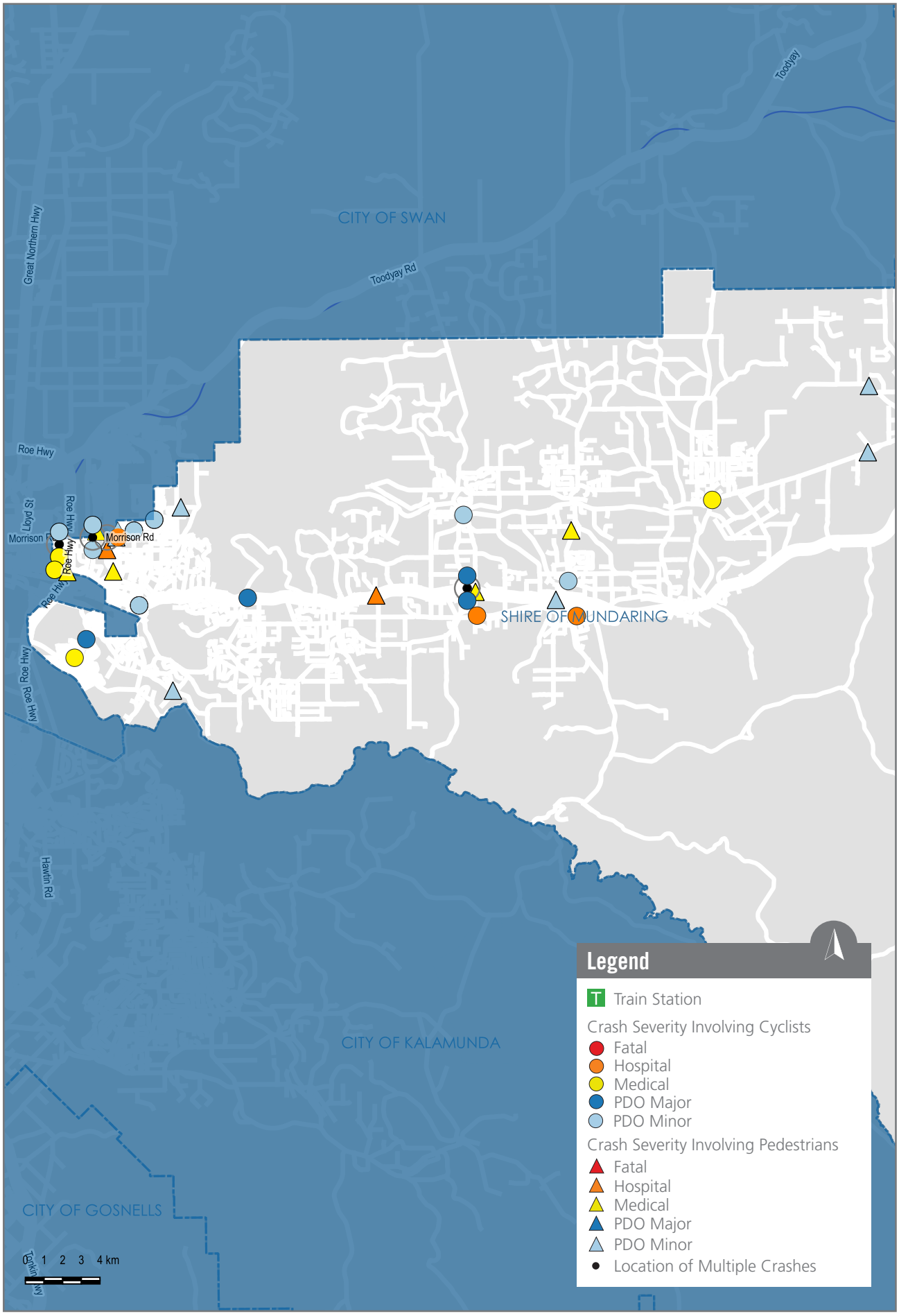
- Education
  - There is a higher percentage of crashes involving motor cycles and heavy vehicles, which could warrant education programs to ensure there is an understanding of the road environment (gravel on road) and overtaking opportunities.
  - Where speed was identified as a factor in the crash, the majority of crashes resulted in medical attention required, hospitalisation or were fatal. This further supports the need for better driver awareness.
- Given the majority of cyclist and pedestrian crashes have occurred along **Morrison Road**, further review to analyse these reasons to could be undertaken to improve the cyclist and pedestrian environment.
- Reasons for the high number of midblock crashes along **Great Eastern Highway** could be further investigated to identify treatment options, noting that **Eastlink** will also reduce traffic (including heavy vehicle traffic) along Great Eastern Highway.
- Detailed analysis of the **Stoneville Road, near Richardson Road** to understand the reason for multiple motor cycle related crashes.

Figure 8.1: Overall Number of Crashes within the Local Government Area



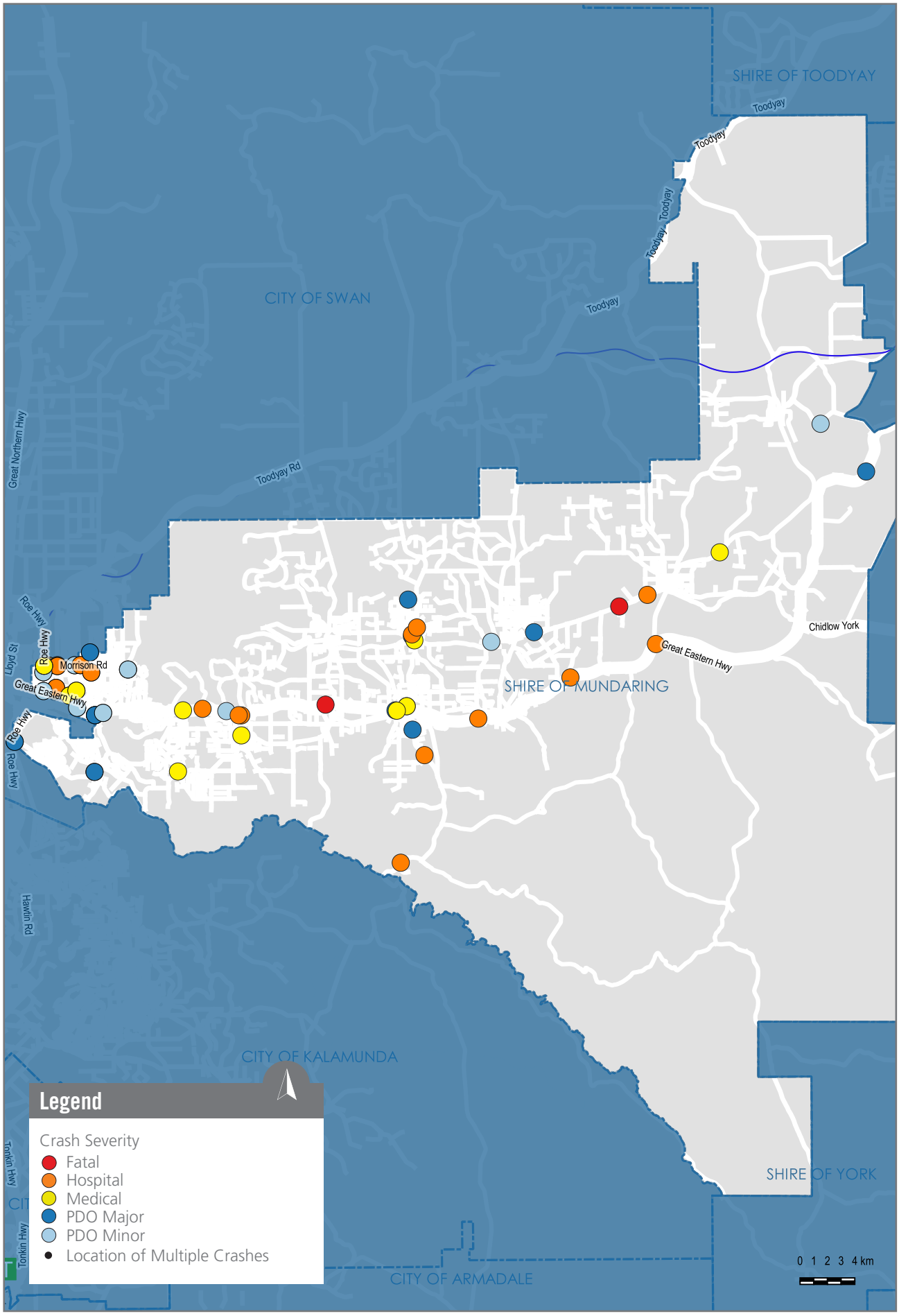
Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 8.2: Cyclist and Pedestrian Crashes within the Local Government Area



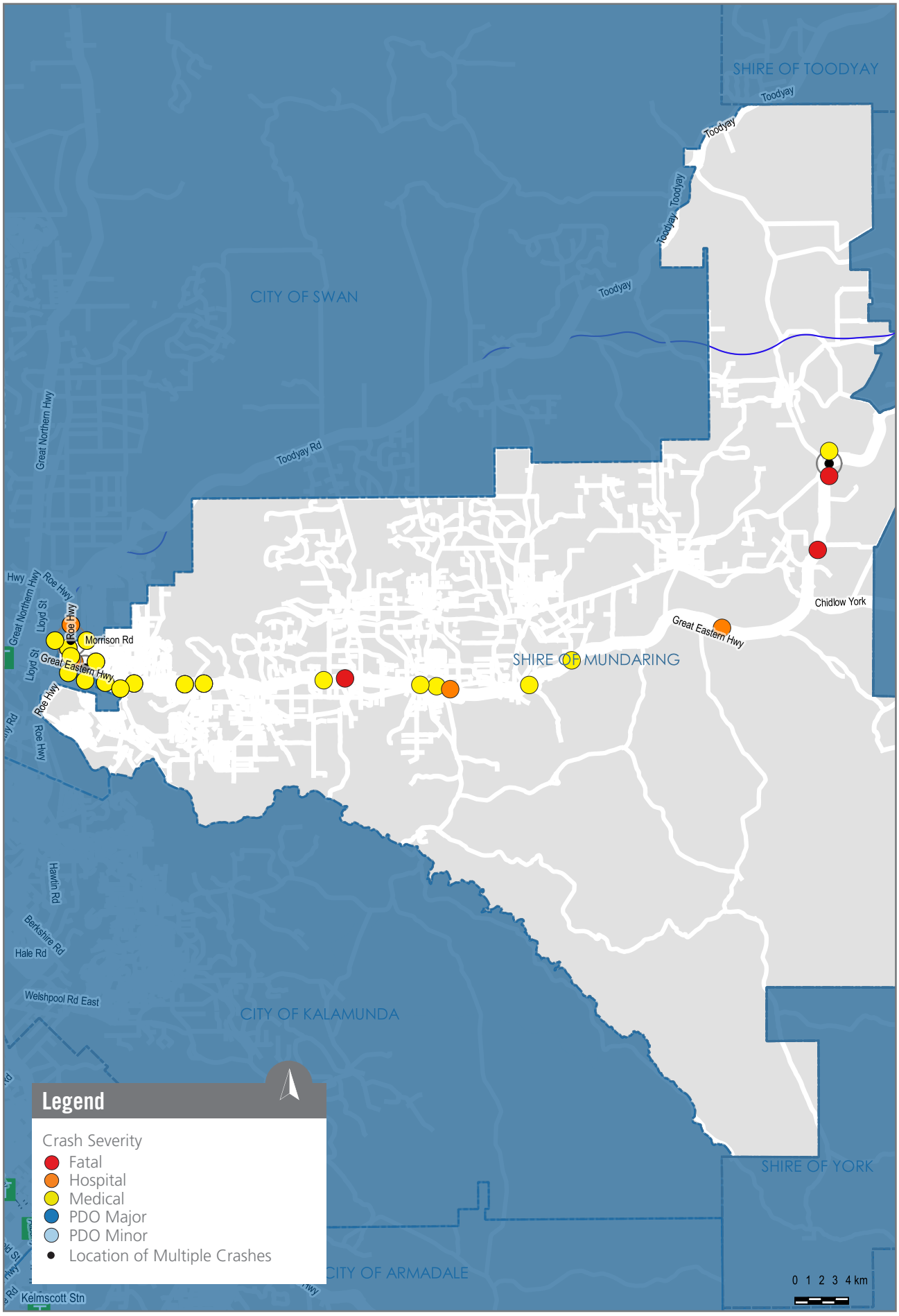
Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 8.3: Motor Cycle Crashes within the Local Government Area



Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 8.4: Killed and Seriously Injured Bus and Heavy Vehicle Crashes within the Local Government Area



Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

9. City of Swan Road Safety Review

9.1. Background

The City of Swan is the northernmost member Council of the EMRC and is approximately between 10 to 50km from the Perth CBD. The City of Swan has a land area of 1,044km2, ERP of 143,374[17] and population density of 1.37 persons per hectare. The City's population has grown rapidly, with the population increasing from 95,206 in 2006 to 143,374 in 2018. The City of Swan is bound by the City of Wanneroo to the west, City of Stirling to the south-west, City of Bayswater, Town of Bassendean and City of Kalamunda to the south, Shire of Mundaring to the east, and Shire of Chittering and Shire of Toodyay to the north.

The southern part of the City of Swan is serviced by four stations on the Midland Train Line, which terminates at Midland Station. A freight railway route also runs north-south within the City. There are also a number of key roads within the City, including Neaves Road, Great Northern Highway, Reid Highway, Roe Highway, Great Eastern Highway and the new Perth-Darwin Highway (Northlink).

The City of Swan area is predominantly regional, with key industries being forestry, agriculture, grazing and viticulture. However, the residential population has grown significantly over the last 30 years and is expected to continue to grow. Key urban growth areas include Midland, Ellenbrook, Henley Brook, The Vines, Brabham, Dayton and Caversham. A large proportion of the area is also National Park, State Forest and nature reserves.

The MRWA crash data for the period between 2013 to 2017 recorded a total of 9,112 crashes within the City of Swan local government area. Of these, 19.2% required medical attention, hospitalisation or were fatal. A high proportion of the killed or seriously injured crashes involving a motor cycle crashes within the City of Swan area were single vehicle crashes were where the driver lost control or attempted to overtake a heavy vehicle.

Population
143,374

Land Area
1,044km²

Density
1,37
persons per hectare

9.2. Literature Review

City of Swan – Integrated Transport Strategy 2014

The Integrated Transport Strategy is noted as an opportunity to create a high-quality integrated planning and transport environment that supports economic, environmental and social activities. Opportunities are noted within core areas of the City, particularly around Activity Centres, but also within Town Centres, local communities and near transport nodes the pedestrian environment forms the basis for transport and land-use synergies and must be considered in the context of the road environment and adjacent land uses.

17 Population Estimate from ProfileID, derived from the Australian Bureau of Statistics Estimated Residential Population 2018

Table 9.1: City of Swan Crash Severity

Severity	Number of Crashes	Percentage
Fatal	30	0.3%
Hospital	351	3.9%
Medical	1367	15.0%
PDO Major	4887	53.6%
PDO Minor	2477	27.2%
Total	**9,112**	**100%**

The Strategy does not have a particular detailed road safety analysis; however, it does try to embed in the recommendations a number of actions which will help improve safety. Examples include a study on rail grade separation, cycle infrastructure implementation, encouragement for the uptake of public transport and pedestrian focussed recommendations and recognising that there is a need for further assessment for specific issues, such as undertaking a study of pedestrian crossing needs along and across strategic corridors (such as Great Eastern Highway).

8.3. Crash Hotspots

9,112 crashes were recorded within the City of Swan between 1 January 2013 and 31 December 2017, which involved 15,492 known units, which include bicycles, cars, heavy vehicles (including buses, trucks, semitrailers, tractors and road trains), motor cycles (including motorised scooters) and pedestrians (including motorised wheelchairs, skateboards, manual scooters and a ridden animal). It is noted that the vehicle type data for 1,662 units were not recorded. 82.8% of crashes involved cars, whilst 3.4% included vulnerable road users including bicycles, motor cycles and pedestrians, which is lower than the EMRC area average of 3.8%. There is a lower percentage of heavy vehicles of 4.2% within the City of Swan when compared with the EMRC area average of 4.6%.

The crash data maps identify a few features within the City of Swan. These are summarised below:

- There is a higher number of crashes involving cars than the EMRC area average, which may be due to a combination of the rapidly increasing urban footprint in the area as well as the rural nature of the area as it transitions towards urbanisation.
- Similar to all the other member Councils, the majority of crashes have occurred along higher order Primary or Distributor roads, including Great Northern Highway, Toodyay Road, Reid Highway, Roe Highway, Guildford Road and Great Eastern Highway as well as Gnangara Road, West Swan Road, Beechboro Road North, Marshall Road, Benara Road and Morrison Road.
- A large number of Local Distributor Roads have also experienced crashes, with notable locations being:

Intersections

- The Broadway / Elmridge Parkway
- The Broadway / Arbor Road (11)
- Mornington Parkway / Coolamon Boulevard (17)
- The Broadway / The Promenade (35)
- Main Street / Commercial Road (15)
- Pinaster Parade / Forestview Boulevard (12)
- The Promenade / Pinaster Parade (9)
- The Promenade / Main Street (34), noting this is directly adjacent to Ellenbrook Central a major trip attractor).
- Pinaster Parade / Woodlake Boulevard (7)
- Henley Brook Avenue / Fortescue Place (11)
- Bushmead Road / Stirling Crescent (15)
- Bushmead Road / Military Road (25)
- Bushmead Road / Helena Valley Road (10)
- Stirling Crescent / Lakes Road (7)
- Railway Parade / Railway Parade (6)
- William Street / Campersic Road (6)
- Haddrill Road / Campersic Road (10)
- Elmridge Parkway / Banrock Drive (12)
- Banrock Drive / Bordeaux Lane (9)

Midblock or Stretch of Road

- Warbook Road (8 plus 16 at the intersection of Great Northern Highway)
- The Promenade between Main Street and Pinaster Parade (20)
- Bushmead Road at/on approach to Robertson Street (6)
- Jinda Road between Wangalla Road and Clayton Street (5)
- Elgee Road between Fairbairn Gardens and Cowan Gardens (8)
- Hooley Road between Cope Street and Ferguson Street (15)
- Talbot Road between Farrall Road and Jane Brook Drive (9)
- O'Brien Road at / on approach to Lancewood Avenue (8), and further north along Clenton Road (11) – the majority of these crashes were single vehicle crashes which were due to lose gravel, swerving to avoid an animal or loss of control of the vehicle, and involved motor cycles. This road winds numerous times, and crashes were recorded near these bends.
- Along Lord Street and New Lord Street between the intersections of Gnangara Road and Reid Highway, there have been 175 crashes, excluding those at the Gnangara Road (85) and Reid Highway (57) intersections. It is noted this data will be affected by the new Lord Street project, as well as revised speed limits and therefore crash rates will change upon completion.
- There have been eight crashes along Henley Brook Avenue between Corich Pass and Gnangara Road, with 21 crashes at the Henley Brook Avenue / Gnangara Road intersection, which is near Aveley Central, a shopping centre and local attractor.
- Mayo Road just south of Toodyay Road (5) – all of which were single vehicle crashes where the driver swerved to avoid an animal, or lost control of the vehicle. Loose gravel was also noted as a reason for a crash.

- There is a high concentration of cyclist crashes along Great Eastern Highway, as well as in the Ellenbrook / Aveley area. Other specific areas of concern for cyclists and pedestrians are:
  - West Swan Road / Meadow Street (6 cyclist)
  - Benara Road / Bennett Street (3 cyclist)
  - Benara Road / Lord Street (2 cyclist)
  - Lord Street / Torley Way (2 cyclist)

Cassowary Drive east of Pelican Parade (3 pedestrian, all requiring medical attention or hospitalisation) noting this location is adjacent two bus stops

  - Illawarra Crescent near Kingfisher Park (4 pedestrian crashes), which is within a school zone.

- The majority of motor cycle related crashes are also generally quite clustered, with key areas being the more urban areas. Multiple crashes occurred at:
  - Gnangara Road / Lord Street (4)
  - Gnangara Road / Beechboro Road North (3)
  - Beach Road / Alexander Drive (3)
  - Beach Road / Bonner Drive (2)
  - Beach Road / Oxleigh Drive (3)
  - Alexander Drive / Truganina Road (2)
  - Morley Drive East / Alton Road (3)
  - Great Northern Highway between West Swan Road and Beryl Avenue (7)
  - Great Northern Highway near Chittering Road (3)
  - Great Eastern Highway between and Helena Street and Bushby Street (19 including 1 fatal and 12 requiring medical attention or hospitalisation)
  - Toodyay Road between Lilydale Road and Old Coach Road (3)
  - Great Northern Highway between Brig Way and Brearley Street (3)
  - Great Eastern Highway Bypass (9).

- The majority of midblock crashes have occurred on higher speed, higher order roads.
- The majority of crashes involving heavy vehicles such as trucks and buses have also occurred on higher speed, higher order roads. In addition to these areas, the Ellenbrook / Aveley area, Malaga industrial area and Midland Town Centre area also have a high instance of heavy vehicle related crashes. Specific locations where multiple crashes have occurred include:
  - Great Eastern Highway between Woodbridge Station and Reid Highway (35)
  - Great Northern Highway / Roe Highway (18)
  - Malaga Drive between Beach Road and Reid Highway (10)
  - Marshall Road / Beechboro Road North (17)
  - The Broadway/ Main Street / The Promenade (5)
  - Alexander Drive between Hepburn Avenue and Reid Highway (19)
  - Roe Highway between Great Eastern Highway Bypass and Helena Valley Road (39)
  - Gnangara Road (12) between Pinaster Parade (9) and Hennessey Road (3) excluding the intersections.
- The City of Swan area has a slightly higher than average percentage of rear end and head on crashes.

Table 9.2: City of Swan Type of Known Vehicles Involved in Crashes

Type of Vehicle	Number of Crashes	Percentage
Bicycle	153	0.9%
Car	14,200	82.8%
Heavy Vehicles	723	4.2%
Motor Cycle	320	1.9%
Pedestrian	96	0.6%
Total (Known)	**15,492**	**90.3%**
Unknown	1,662	9.7%

Table 9.3: City of Swan Crash Type

Crash Type	Number of Crashes	Percentage
Head On	117	1.3%
Hit Animal	68	0.7%
Hit Object	754	8.3%
Hit Pedestrian	92	1.0%
Non-Collision	140	1.5%
Rear End	4356	47.8%
Right Angle	1778	19.5%
Right Turn Through	545	6.0%
Sideswipe Same Direction	901	9.9%
Total (Known)	**8751**	**96.0%**
Unknown	361	4.0%

Table 9.4: City of Swan Midblock vs Intersection Crash

Location	Number of Crashes	Percentage
Intersection	5,247	57.6%
Midblock	3,865	42.4%
Total	**9,112**	**100%**

9.4. High Risk Areas

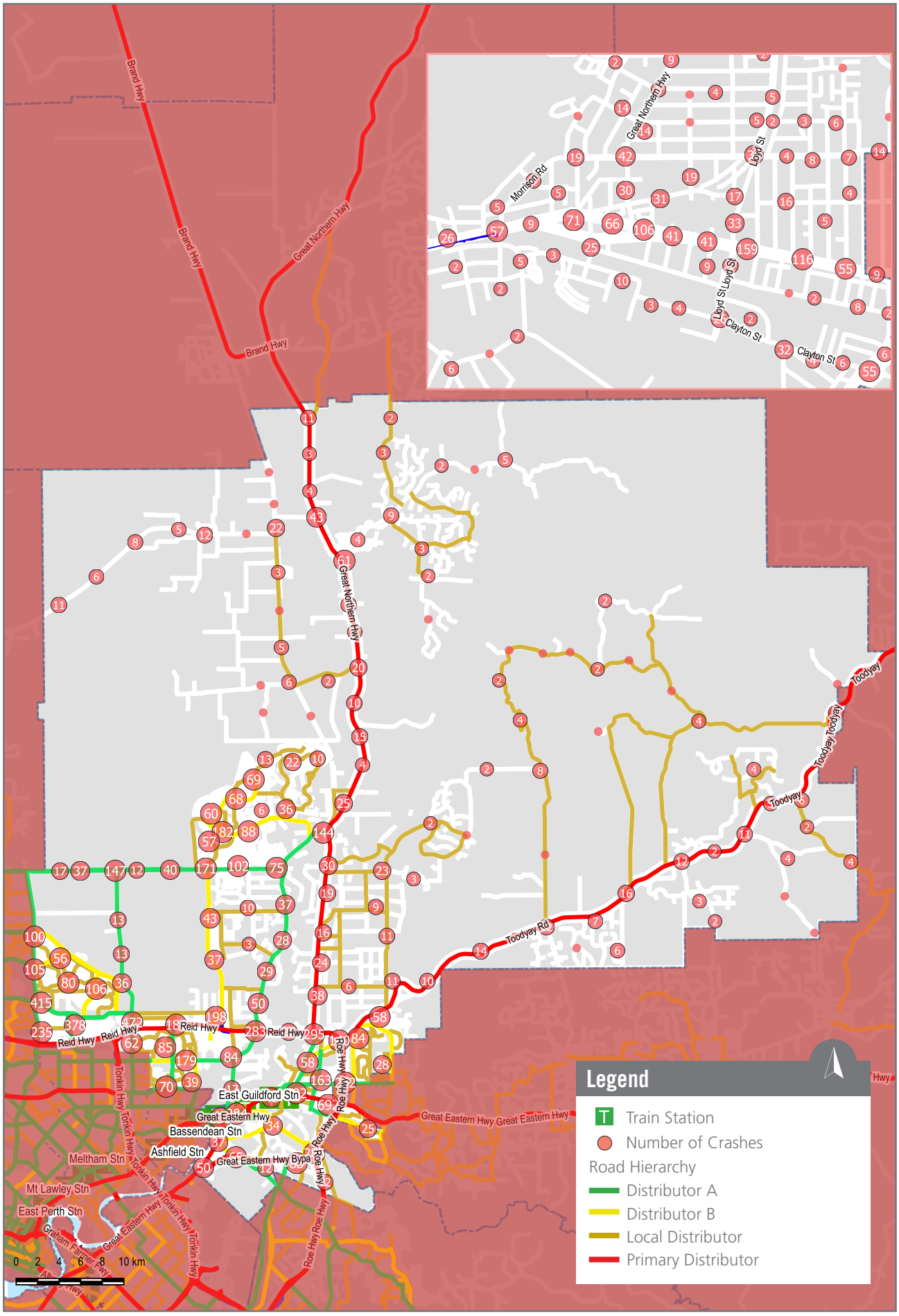
The City of Swan is a rapidly urbanising local government area with a combination or rural and residential areas. Within the City of Swan, a number of locations which were identified to have a higher number of crashes were also granted Black Spot Program funding including:

- Morrison Road / Farrall Road
- Great Eastern Highway / Ferguson Street
- Coolamon Boulevard / Mornington Parkway
- O'Brien Road
- Clenton Road
- Marshall Road / Trade Road / Business Way.

The following recommendations are made for the City of Swan:

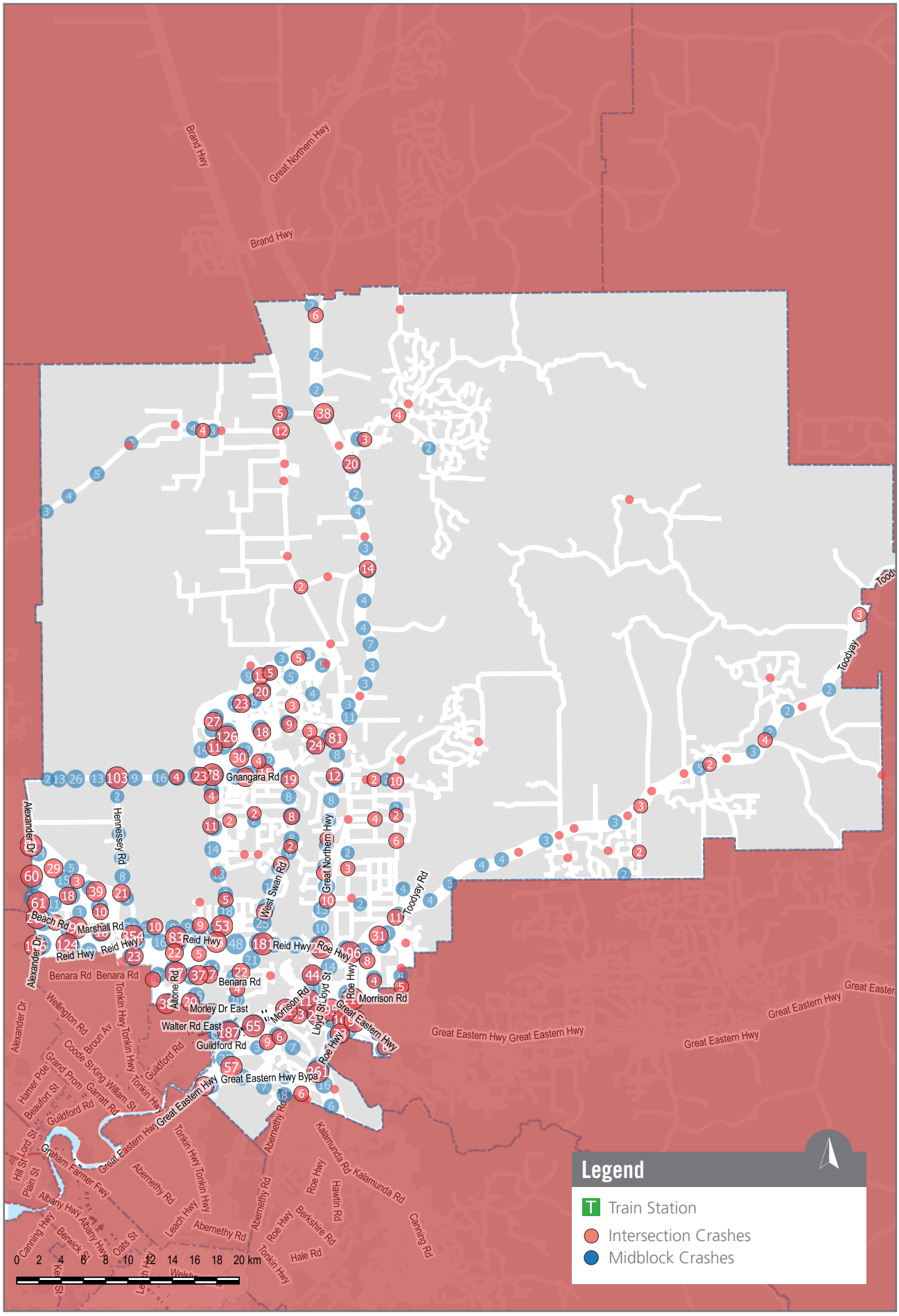
- Vulnerable road users
  - Illawarra Crescent near Kingfisher Park (4 pedestrian crashes) – review of crossing facilities
  - Cassowary Drive east of Pelican Parade (3 pedestrian, all requiring medical attention or hospitalisation) noting this location is adjacent two bus stops – review of crossing facilities
  - West Swan Road / Meadow Street (6 cyclists) – further analysis of reasons for crashes.
- Further review of the following locations which have had a number of motor cycle related crashes:
  - Great Eastern Highway between and Helena Street and Bushby Street (19 including 1 fatal and 12 requiring medical attention or hospitalisation)
  - Great Northern Highway between West Swan Road and Beryl Avenue (7)
  - Great Eastern Highway Bypass (9)
  - Great Northern Highway near Chittering Road (3)
  - Alexander Drive / Truganina Road (2)
  - Reid Highway / Beechboro Road North (3)
  - Toodyay Road between Lilydale Road and Old Coach Road (3).
  - Beach Road / Alexander Drive (3)
  - Beach Road / Bonner Drive (2)
  - Beach Road / Oxleigh Drive (3)
- Further review of heavy vehicle crashes at the following locations:
  - Great Eastern Highway between Woodbridge Station and Reid Highway (35)
  - Great Northern Highway / Roe Highway (18)
  - Malaga Drive between Beach Road and Reid Highway (10)
  - Marshall Road / Beechboro Road North (17)
  - The Broadway near Main Street (5)
  - Alexander Drive between Hepburn Avenue and Reid Highway (19)
  - Roe Highway between Great Eastern Highway Bypass and Helena Valley Road (39)
  - Gnangara Road (24) between Pinaster Parade and Hennessey Road excluding the intersections.
- Driver education – majority of crashes involving heavy vehicles have also occurred on higher speed, higher order roads. Awareness of heavy vehicle stopping distances or overtaking lanes could be considered.

Figure 9.1: Overall Number of Crashes within the Local Government Area



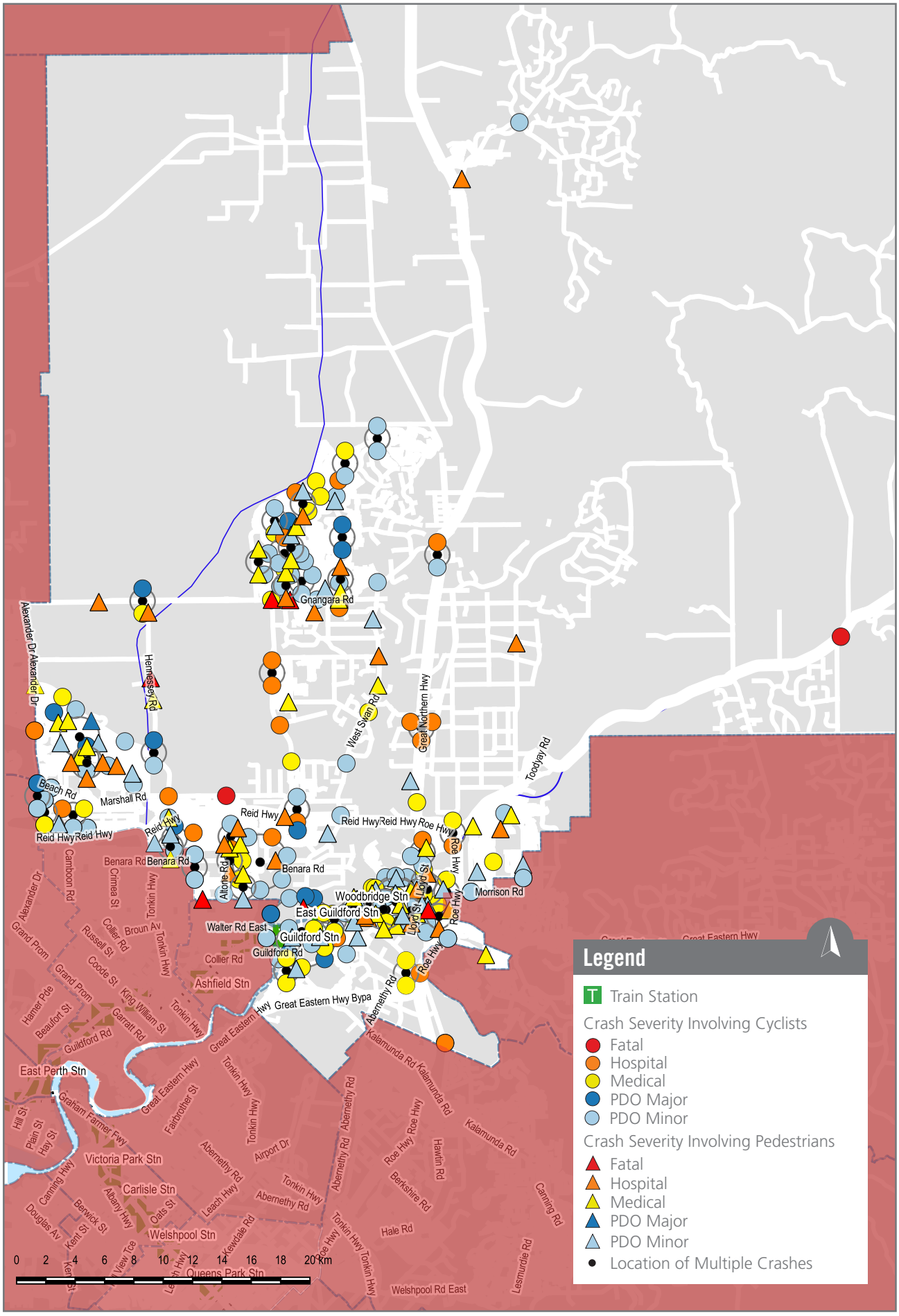
Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 9.2: Overall Midblock vs Intersection Crashes within the Local Government Area



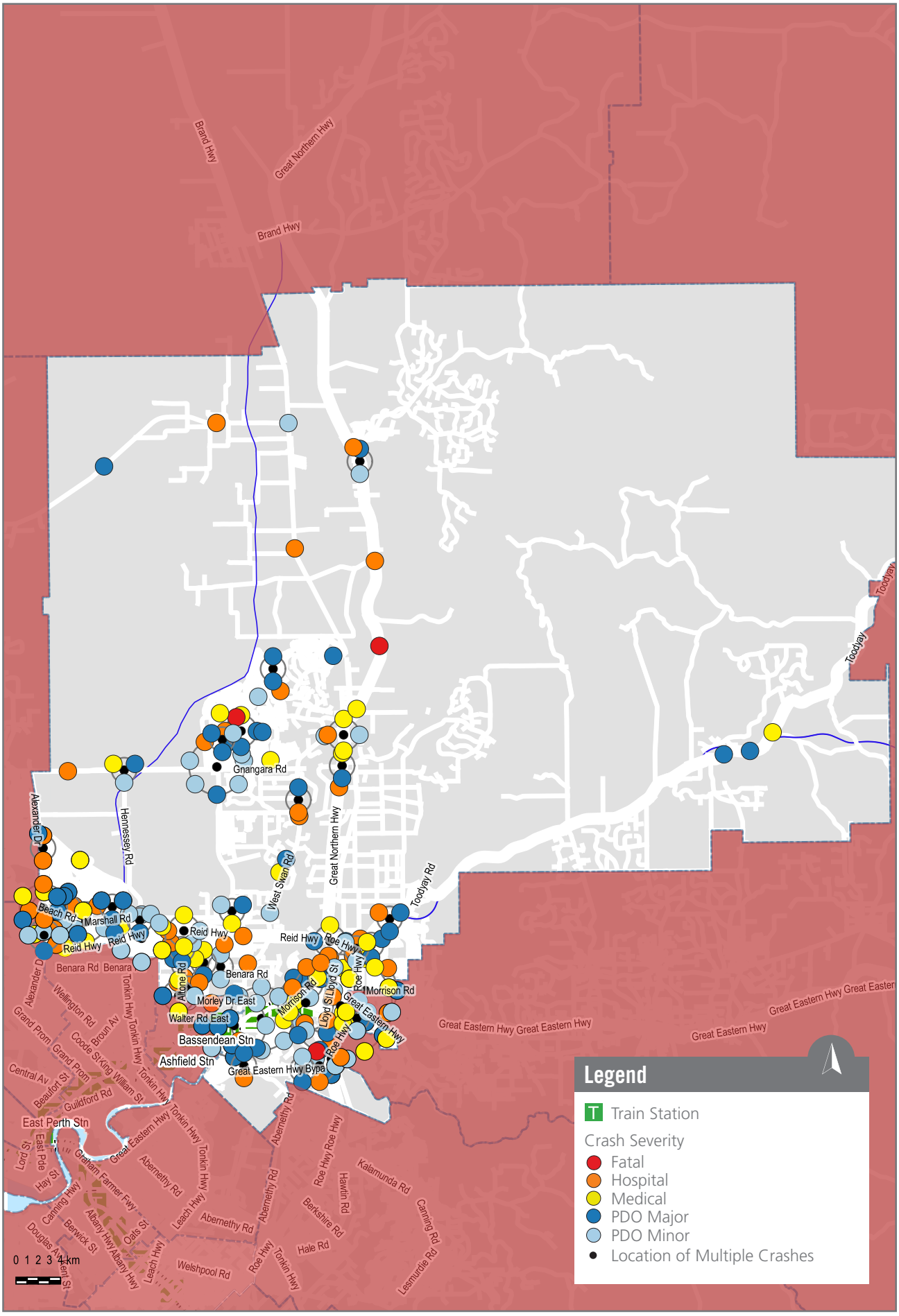
Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 9.3: Cyclist and Pedestrian Crashes within the Local Government Area



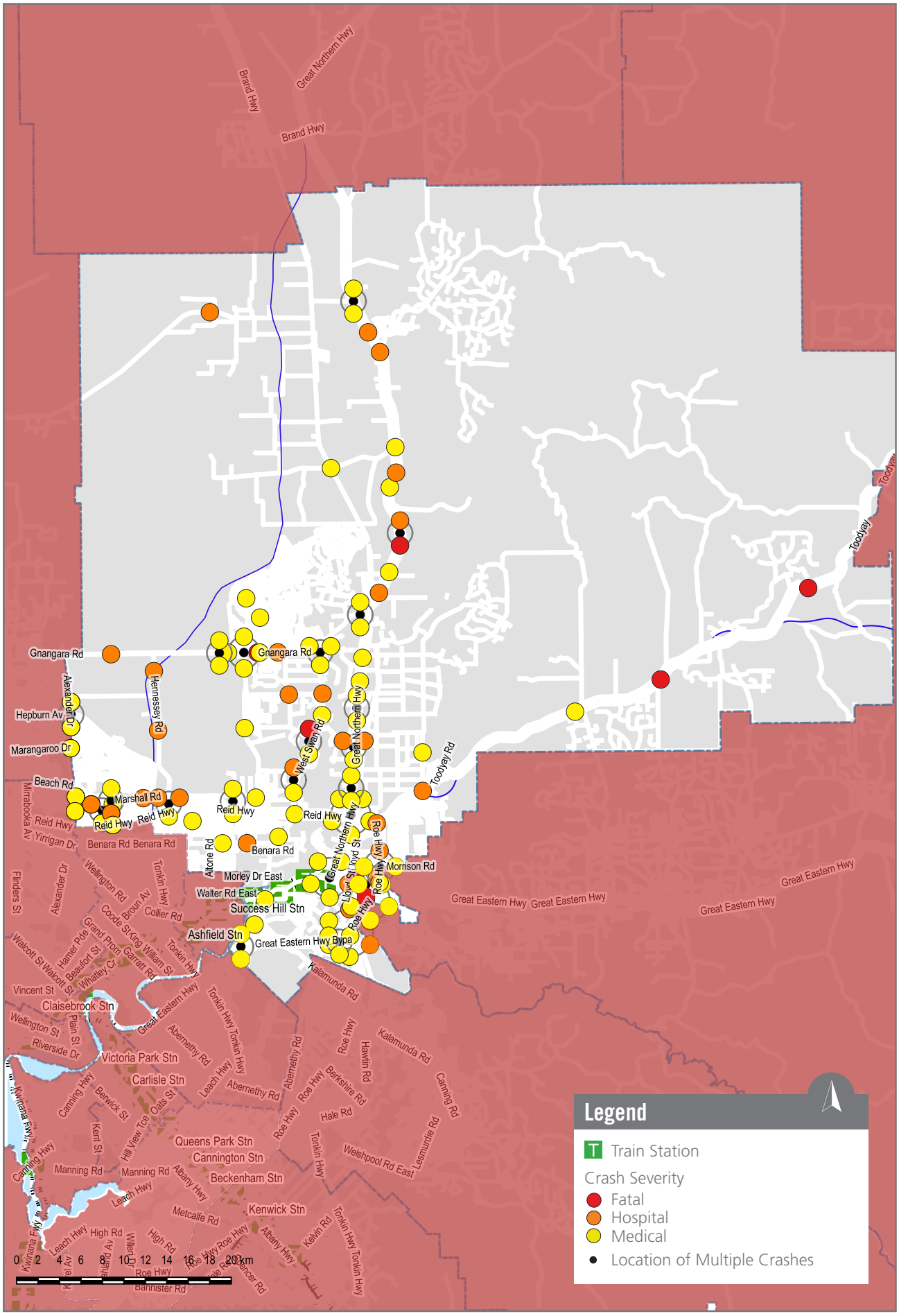
Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 9.4: Motor Cycle Crashes within the Local Government Area



Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

Figure 9.5: Killed and Seriously Injured Bus and Heavy Vehicle Crashes within the Local Government Area



Data Source: Main Roads WA Crash Analysis Reporting System (CARS) - Period 2013 to 2017

10. Future Considerations

It is important for member Councils to be kept up to date with current and future vehicle technology and its effect on improving road safety and the safety of the road users within the EMRC region. Vehicle technology will progress through the advent of an increase in safety features within vehicles as they become standard design as well as a move toward connected and autonomous vehicles.

10.1. Australian Design Rules

The Australian Design Rules (ADRs) are national standards for vehicle safety, anti-theft and emissions. The ADRs are generally performance based and cover issues such as occupant protection, structures, lighting, noise, engine exhaust emissions, braking and a range of miscellaneous items.

The development of the ADRs continues as part of a normal program of review and revision. The program includes monitoring international developments and involves regular consultation with the Department's key stakeholders. This identifies implementation issues or changes in factors affecting existing ADRs, as well as any need to introduce new ADRs. The ADRs are also subject to a full review where possible every ten years to ensure they remain relevant, cost effective, and do not become a barrier to importation of safer vehicles and vehicle components.

It is noted that, within the ADRs in addition to the standard requirement for safety in vehicles (such as airbags, seatbelts, headlights etc, only two 'newer' technological based safety features are now standard. These being:

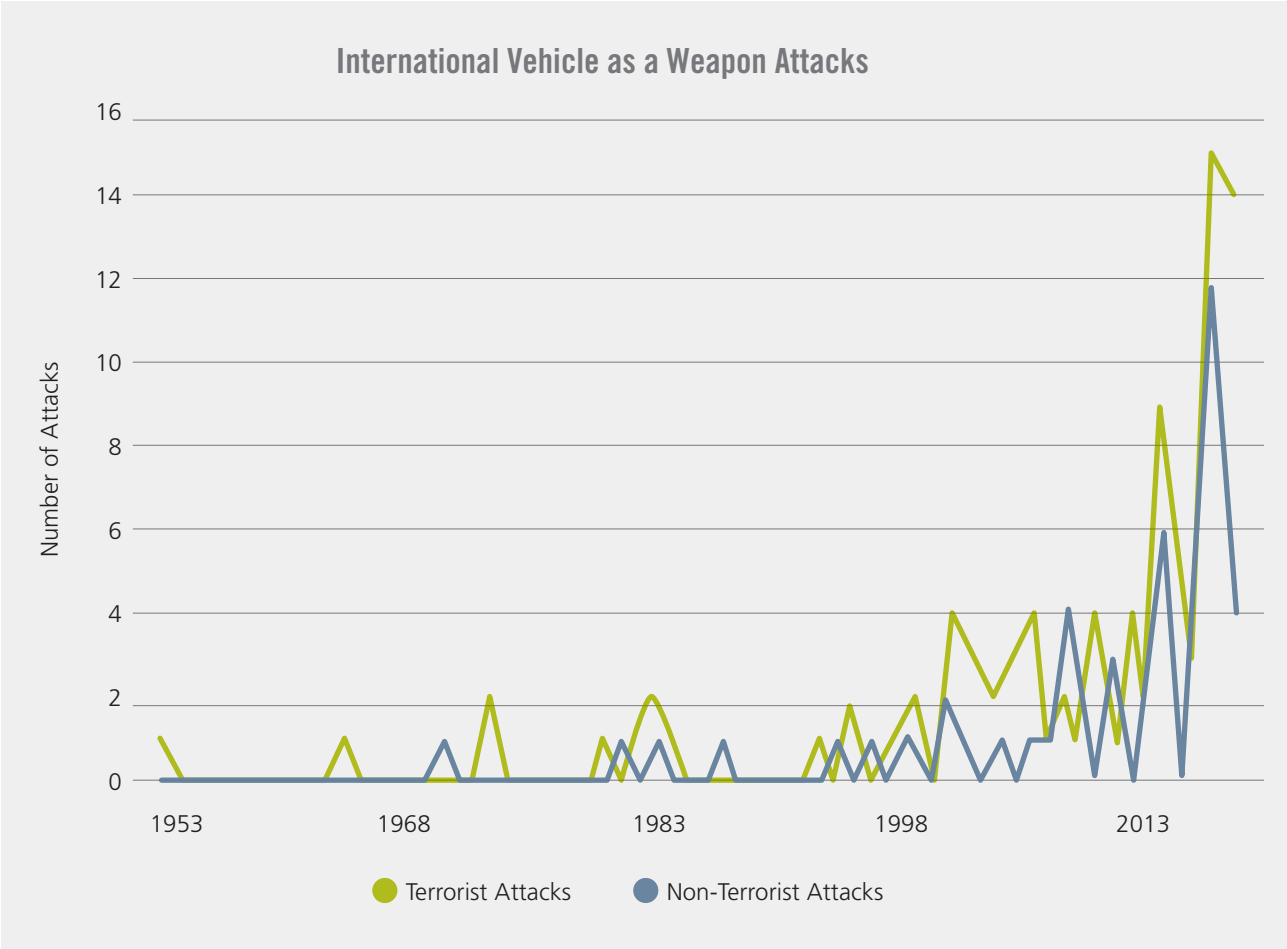
- Electronic Stability Control (ESC), and
- Brake Assist Systems (BAS).

Within its role as an advocacy body, the EMRC could work with other advocacy organisations such as WALGA and RAC to assess deficiencies within the Australian Design Rules for vehicles with a view to lobbying Federal and State Government in including new safety features on vehicles as standard. An example of this could be advocacy to seek that Australian Design Rules incorporate mandatory ESC for motorbikes, and Autonomous Emergency Braking (AEB) for light vehicles, which has been mandatory within the design rules of some European Countries for many years.

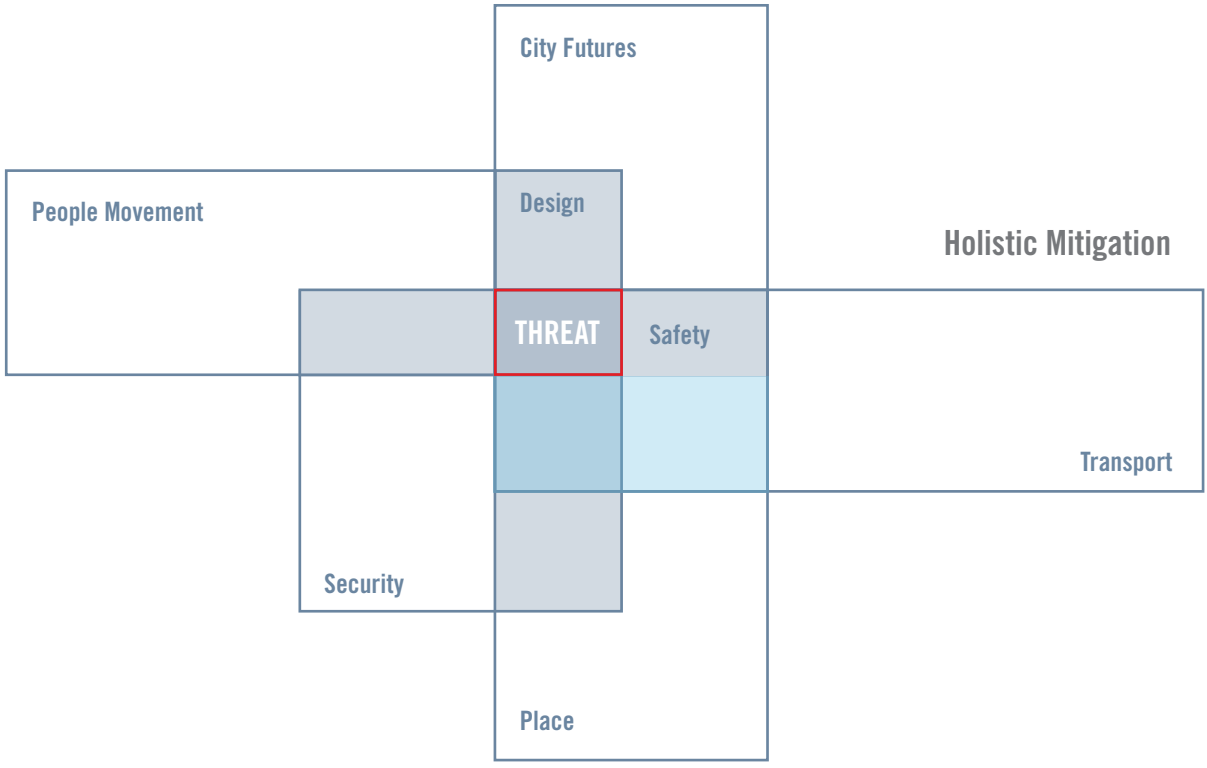
10.2. Hostile Vehicle Mitigation

Vehicle as a Weapon (VaW) attacks have been rapidly rising in recent years with a shift in focus to understand, at the local level potential threat areas. As with the unfortunate events recently in Melbourne and elsewhere around the world, planning has not been undertaken for these random, rare attacks with cities having to be reactive. Ensuring a proactive planning approach for this will assist member Councils to work toward the safety of their local community and those that visit.

Vehicle technology will progress through the advent of an increase in safety features within vehicles as they become standard design as well as a move toward connected and autonomous vehicles.



Due to the nature of VaW attacks being opportunistic single vehicle planning is often difficult. Transport planning and design can play a key role toward mitigation of VaW attacks through the design of movement and place infrastructure providing a buffer and sometimes a barrier between a VaW and a Place.



10.3. Autonomous Vehicles

Autonomous Vehicles (AVs) are one example of a number of emerging technologies which will impact on demography and the ways we think about infrastructure funding. Together with evolving social norms and changing personal preferences these developments are combining to change the way people live, cities operate, and agencies deliver their services. The exact detail of how these trends will play out is unclear, but two things can be asserted with some certainty: their impacts will be substantial, and they will be broad ranging. Changes in transport technology will not just affect the way we travel, but will affect the way we spend our time, how we spend our money, the way we live and, where we live. They will have knock on impacts on how urban areas operate, and the way transport infrastructure is provided and managed.

AVs and other emerging transport technologies will create significant challenges for road and transport agencies. To meet those challenges and make appropriate investments for the long-term – agencies need to understand the nature of the changes prompted by these technologies. To generate insights into how our cities may evolve in the presence of new transport technologies member Councils may need to address the following questions:

- What transport modes will be available?
- How will people choose their mode?
- What triggers and thresholds will drive mode shift?
- What investment is called for in AVs and who will make it?
- How might funding of infrastructure and cost recovery change in the presence of AVs?

11. Road Safety Recommendations

11.1. Applying a True 'System' Approach to Road Safety

The following assessment and analysis has been provided by Brett Hughes of P7 Safety.

Since the 1930s, road safety has undergone several evolutions, about every 15 years, the most recent of which is known in Australia as Safe System. While these phases have slightly different language and emphasis, they remain firmly based on three E's (Education, Enforcement and Engineering) simply applied to drivers, vehicles and roads. The resulting actions most commonly included in road safety strategies are therefore largely the same three: road engineering and driver education and enforcement.

Since the 1930s, road safety has undergone several evolutions, about every 15 years, the most recent of which is known in Australia as Safe System.

Safety management in industrial contexts followed a similar path, based on the human-machine-local environment model. Typical analysis and response followed simple models such as Reason's 'domino' model of causality where one event triggered others that caused a crash, the 'Swiss Cheese' model to identify a cause of a crash and the hierarchy of interventions model to manage and prevent future events.

Aviation safety followed a different path and improved safety based on another management approach apparently because aviation was so complex that many things could go wrong and sometimes several at the same time. Causes were often beyond the pilot and airplane alone and there was little infrastructure involvement. Aviation also developed very intensive crash investigation, that was based on a no-blame or 'just culture' principle which protected information from being used for prosecutions. When Capt. Sullenberger control-crashed the 'Miracle on the Hudson' it wasn't only because he was a great pilot, but also because of a multitude of complementary elements that had been developed according to complex system safety management over many decades.

Road safety has also suffered 'siloed' actions of separate participants acting in isolation. A true systems approach takes account of all of the parts and participants and thoroughly applies integrated policy tools to achieve the most efficient and effective improvements.

Systems Approaches have strong theoretical, research and practical foundations. With a diverse history in biology and electronics, it has been successfully applied in several relevant fields, such as safety, reliability engineering and information technology, but not in government policy, planning and service delivery. So, if it was applied to these activities (such as this Road Safety Plan) it may be addressed as:

> *Participants use processes based on principles to apply policy tools to affect contributing parts, in order to achieve a purpose (economic, social and environmental improvement). These all occur in complex interdependent partnerships or influences of change within the system*[18].

18 Brett Hughes, P7 Systems Approach

11.1.1. Application of the P7 System Approach

The P7 system approach can be applied to ensure a broader understanding required for the individual recommendations being provided within this Plan. The 7 Ps are:

P7 system approach

- **PURPOSE** – a clear statement of the Plan objectives (The Vision).
- **PARTS** – influence and respond to other parts of the system. Transport (road, cycling, pedestrians, public transport, freight, air), users (professional drivers, commuters, domestics, operators etc), information (signs, wayfinding, zoning, traffic management etc) and policies.
- **PARTICIPANTS** – all the individuals and groups who use and affect the system and who can make a difference, including the EMRC's Regional Integrated Transport Strategy (RITS) Implementation Advisory Group (IAG) members.
- **POLICY TOOLS** – the actions that participants apply to the parts that do and do not work toward the purpose. These are used to validate the Vision within a Safe System approach. What can key stakeholders and member Councils do to ensure the Vision is achieved.
- **PARTNERSHIPS** – understanding and documenting the relationships and interactions between the participants (users of the system), the parts (how they use the system) and the policy tools and how the approving authorities can ensure this relationship is enhanced and understood.
- **PRINCIPLES** – setting the direction of the Plan, ensuring ownership of identified recommendations and advocating for a safer system.
- **PROCESSES** – a toolkit (the Plan) detailing the research and analysis undertaken, techniques for management and advocacy, program of deliverables and recommendations.

The P7 system approach has been adapted and applied in the recommendations section of this plan.

11.2. EMRC Regional Road Safety Plan Recommendations

Table 9.2: City of Swan Type of Known Vehicles Involved in Crashes

No	Purpose (Issue)	Participants (Parties Involved)	Principles	Processes and Policies (Actions)
SAFE USER				
1	Higher than average number of pedestrian related crashes within the Town of Bassendean Kalamunda Town Centre pedestrian related crashes and poor walkable environment.	EMRC, Town of Bassendean and MRWA EMRC, City of Kalamunda and MRWA	Ensure pedestrian infrastructure is provided to protect pedestrians from traffic and/ or ensure speeds are lowered to the survivable limits of vulnerable road users	EMRC to work with the Town to develop local policies and practices that support safe pedestrian environments. Develop guidelines for design interventions for road construction and built Environment towards pedestrian needs and comply with the Safe Systems Guidelines. EMRC to work with the City of Kalamunda to ensure pedestrian safety assessments are in accordance with Safe System principles of are undertaken as part of the Kalamunda Town Centre upgrade.
2	1. High percentage of vulnerable road user crashes which include motor cycle crashes that may not be addressed within the City of Bayswater Traffic Management Plans 2. A number of intersections with higher percentage of vulnerable road user crashes which include motor cycle crashes. Intersections are along routes identified within Belmont's Sustainable Transport Plan 3. Motor cycle riders are at greater risk of being killed or seriously injured as a result of a crash at intersections due to their vulnerability. • Altone Road and Morley Drive East • Anstey Road and North Road 4. A number of roads and intersections within the City of Swan with higher percentage of motor cycle crashes highlighted within this Action Plan.	EMRC, Town of Bayswater and MRWA EMRC, City of Belmont and MRWA EMRC, City of Swan and MRWA	Ensuring a Safe System approach is undertaken recognising pedestrian, cyclists and motor cycle vulnerability and survivable limits. Safe System assessment along an entire corridor to improve the safety for all road users	EMRC to work with the City of Bayswater to undertake a safety assessment and assist in advocating for funding to implement recommendations EMRC to facilitate a meeting with the City of Bayswater and Department of Transport to plan and design for Safe Active Streets. EMRC to work with the City of Belmont to undertake a safety assessment and assist in advocating for funding to implement recommendations. EMRC to facilitate a meeting with the City of Belmont and Department of Transport to plan and design for Safe Active Streets. EMRC to work with the City of Swan to undertake a road safety assessment on key roads with a motorcycle crash issue and assist in advocating for funding to implement recommendations.

No	Purpose (Issue)	Participants (Parties Involved)	Principles	Processes and Policies (Actions)
3	Understanding of Safe System within the member Councils (noting each Council will have differing knowledge in this area).	EMRC, member Councils, WALGA, MRWA and Road Safety Commission	All member Council employees involved with planning, designing and maintaining the road network utilise Safe System to progressively increase the safety of the road network for all road users	EMRC to work with WALGA to promote the use of WALGA Safe System Guiding Principles for Local Government to member Councils. EMRC to advocate for member Councils employees to utilise the MRWA Road Safety Audit and Road Safety Engineering modules for employee training. EMRC to advocate for member Councils leadership team to apply to attend the Road Safety Commission Executive Road Safety Leadership Program.
4	National and State crash rates of killed and seriously injured shows over-representation of younger drivers (less than 29yrs).	EMRC, member Councils, WALGA and SDERA	No school child begins their journey to becoming a driver without having first received Safe Road Use training. All school children should have safe route to travel to school.	EMRC to work with member Councils to ensure all High School children within each member Council receive safe road use education. All schools within each member Council progressively have a Safe Routes to School assessment.
5	Lack of Road Safety understanding within the wider EMRC community.	EMRC, WALGA and Community	EMRC and WALGA to work with the member Councils to educate the wider community on Safe System and everyone's part to play	A suggestion within the Safety Workshop was for EMRC and WALGA to have a presence at community events. EMRC and WALGA can also work with each member Council and other agencies (such as Department of Transport) to improve messaging around safe system projects, such as Safe Active Street development, road rules for giving way to pedestrians etc.

No	Purpose (Issue)	Participants (Parties Involved)	Principles	Processes and Policies (Actions)
6	Transport projects undertaken within member Council areas need to transition towards ensuring Safe System principles are the primary objective.	EMRC, member Councils, WALGA, MRWA	A representative from each member Council to form a Safe System design review panel chaired by EMRC to assist Council with Safe System transition	EMRC to organize a Safe System design review panel, with one or two representatives from each member Council, plus a representative from WALGA and MRWA to review road designs (above a certain value) from each member Council.
7	Responding to localised transport issues experienced adjacent to local government boundaries can result in traffic and road safety issues being transferred from one Council area to another.	EMRC	Each member Council when addressing traffic and road safety issues that may affect cross boundary travel do not implement solutions that transfer the problem to adjacent Councils	To provide high level advocacy to be targeted towards both State and Federal governments.
SAFE VEHICLES				
8	The general public vehicle fleet currently on the road in WA is over ten years old (on average). Research shows older vehicles drastically increase the severity outcome of a crash.	EMRC, member Councils and WALGA	No employee within the member Councils will have to undertake work duties in an unsafe vehicle	EMRC to work with member Councils and WALGA to use the RoadWise Safe Vehicle Policy or adapt and develop their own
SAFE ROADS AND ROADSIDE				
9	Town of Bassendean has a higher number of crashes along Guildford Road and Railway Parade especially at west End Collier Road and intersection.	EMRC, Town of Bassendean and MRWA	Safe System principles should be followed to ensure corridor studies assess human tolerances to crash forces	A corridor study can be considered for these roads to further analyse these routes in accordance with the state principles.
10	High number of crashes along identified corridors • Walter Road West, Russell Street, Beechboro Road South – City of Bayswater • Francisco Street, Kooyong Road, Fulham Street and Hardey Road – City of Belmont • Morrison Road and Stoneville Road.	EMRC, City of Bayswater and MRWA EMRC, City of Belmont and MRWA EMRC, Shire of Mundaring and MRWA	Ensuring a Safe System approach is undertaken recognising pedestrian, cyclists and motor cycle vulnerability and survivable limits and the human tolerance to crash forces	To develop a Safe System process for corridor reviews and assist in advocating for funding to implement recommendations. EMRC to work with the Shire of Mundaring to undertake a Safe System transition project accordance with Safe System principles and assist in advocating for funding to implement recommendations.

No	Purpose (Issue)	Participants (Parties Involved)	Principles	Processes and Policies (Actions)
11	Lack of funding for East-Link, resulting in Mundaring Town Centre pedestrian related crashes and poor walkable environment.	EMRC, Shire of Mundaring and Department of Transport.	Improving the pedestrian environment for all users, ensuring Safe System ultimate aim by reducing road speeds to vulnerable road user survivable limits	EMRC to work with the Shire of Mundaring to undertake a Mundaring Town Centre walkability assessment in accordance with DoT Planning and Designing for Pedestrians guidelines with an aim to achieve a Safe System environment for pedestrians (and ultimately cyclists).
12	A number of roads and intersections within the City of Swan with higher percentage of heavy vehicle related crashes highlighted within this action plan	EMRC, MRWA Heavy Vehicles and member Councils	Ensuring a Safe System approach is taken recognising heavy vehicle mass and speed correlation to stopping distances as well as the disparity between large heavy vehicles and vulnerable road users	EMRC to work with member Councils to undertake a detailed study to understand the causality of the crashes involving heavy vehicles at the identified locations within this plan and assist in advocating for funding to implement recommendations.
13	Formal Road Safety Audit procedures have not been adopted by all member Councils to ensure a constant approach to safe system road safety auditing	EMRC, WALGA and member Councils	Audit policy ensures a commitment is adopted by Council for the implementation of road safety audit principles and practices in the planning and development of infrastructure within each member Council	EMRC to work with WALGA and each member Council to adopt the WALGA Road Safety Auditing policy or produce a similar policy for their Council. To set up network performance indicators relating to road safety.
SAFE SPEEDS				
14	High instances of crashes occurring when overtaking as well as single vehicle run-off road crashes. Such as Lesmurdie Road / Welshpool Road East intersection	EMRC, City of Kalamunda and MRWA	Transitioning rural roads to a fully Safe System through progressive safe system upgrades	EMRC to work with the City of Kalamunda to undertake a Safe System transition project in accordance with Safe System principles and assist in advocating for funding to implement recommendations
15	Shire of Mundaring experiences high instances of crashes occurring when overtaking as well as single vehicle run-off road crashes such as Morrison Road ad Stoneville Road	EMRC, Shire of Mundaring and MRWA	Transitioning rural roads to a fully Safe System through progressive safe system upgrades	EMRC to work with the Shire of Mundaring to undertake a Safe System transition project accordance with Safe System principles and assist in advocating for funding to implement recommendations
16	Speed reform – appropriate speeds for roads – lowering speeds for local neighbourhood roads and school zones	Main Roads WA Speed Zoning Policy and member Council community plans	Safe System principles states areas with expected vulnerable road user activity should have lower speeds	EMRC to work with member Councils to establish a 40km/h area speed zone trial and/or establish a 30km/h School Zone trial

Appendix A: Safety Workshop Summary

Key themes discussed in the Safety Workshop include vulnerable road users, congestion, safety issues and the impact of State Government Projects. The key points for each of these themes are summarised below.

Key themes discussed in the Safety Workshop include vulnerable road users, congestion, safety issues and the impact of State Government Projects.

Vulnerable Road Users

- There should be more consideration of gophers as the aging population grows, including appropriate networks, path widths, routes etc.
- User conflicts due to technology advancing, which includes electric scooter use of footpaths or in cycle lanes as well as E-Bikes on shared paths.
- Inadequate infrastructure to adequately separate modes of different size and speed – such as cyclists and heavy vehicles or traffic and pedestrians in town/ activity centres.
- Lack of safe pedestrian and cycle crossings on strategic and distributer roads.
- School Zones – current 40km/h speed limits and the small amount of time the reduced speed limit is actually in operation.
- Safe Active Street concept was noted as a good concept that works well however there is a lack of understanding of the concept, which may be a cultural issue where cycling is not heavily incorporated or considered a mode of transport.
- There was general consensus that town centres should be more 'walkable'. EMRC could assess what this means for the region.
- Managing the use of footpaths by cycles when crossing driveways. Who gives way to who? – an understanding of the Road Traffic Code 2000.

Congestion

- Impact of congestion on impatient risky behaviour driving.
- Forecast congestion effecting regional freight movements and the impact on road safety.
- Lack of suitable and safe strategic road linking to the Eastern regions (EastLink).
- Impact of rail level crossings, and the associated congestion.

Safety Issues

- Single vehicle run-off road issues in more rural areas (Swan, Mundaring and Kalamunda).
- Traffic speed issues in general. It was also noted that there are inappropriate speeds on some roads or in some areas, which could trigger a speed reform.
- Strategic Roads cutting through neighbourhoods causing disconnect between communities proving difficult for crossing – such as Guildford Road through Bassendean, Tonkin Highway through Redcliffe and Great Eastern Highway through the City of Belmont.
- Hostile environments and safety, and the role of member Councils in addressing issues such as the 'Vehicle as a Weapon' issue.
- A number of pedestrian incidents in town centres were mentioned. Especially around the aging population and incidents with elderly pedestrians.
- General speed reform discussion, noting RAC are currently researching 'Safe Speeds' as a key issue. We should ensure the right speeds are posted for the right roads. Lower speeds for areas of high vulnerable road user activity. Great Eastern Highway (through Belmont) was noted as an example as inappropriate low speed for a key arterial vehicle and freight route (noting reason why the speed is 60km/h is likely due to the on-road cycling, which is a poor design outcome).
- Rail level crossings are problematic, create congestion and are also a safety issue.
- Sometimes neighbouring council projects move more traffic into council areas that cannot be safely catered for. More liaison and inter-council working needs to occur to ensure transport and road safety plans are aligned across the EMRC boundary.
- It was noted that a road safety plan should have a focus on KSI's rather than all crashes. While all crashes will be considered, high level assessment within this Plan has largely been around all types of crashes and Safe System crash types.
- Near-misses are often reported anecdotally, with no formal procedure. Council sometimes receive emails, but not consistently. The query was posed that perhaps EMRC could assess the potential for a government run central reporting system for near misses etc.
- Education and awareness programs region wide should be ongoing and not just one-off programs. EMRC could play a role in this to help manage behaviours directly. For example, road safety stalls and community events run by EMRC could be a consideration, as well as partnering with WALGA to further promote the RoadWise program. Also, additional information and messaging around the concept of Safe Active Streets, including the intent, role and that cars should give way to pedestrians etc.
- Speed in general and speed limits were also noted as key concerns. Speed reform is required so that the right speed for the right roads are allocated based on a system approach and not through the traditional engineering approach.

Impact of State Government Projects

- The Tonkin Highway / Hale Road access closure will result in an increased number of vehicles and freight traffic rerouting along local roads, potentially mixing with pedestrians.
- Lack of committed funding (Federal and State) for East Link means Mundaring townsite continue to affect safety for vulnerable road users.
- Bayswater Station upgrade by METRONET results in Whatley Crescent being restricted a single lane access, which could potentially have a wider impact on safety of the area.
- The new Ellenbrook Railway Line could have a road safety impact on the Town of Bayswater, which would require further investigation and review.
- MRS amendment for Guildford Road was not approved. There is potential for head on collisions at higher speeds and right angle crashes at intersections at higher speed due to widening works not occurring.
- It was noted that more railway level crossings to be funded so they can be removed at locations such as Railway Parade & Caledonian Ave and Guildford Rd & Railway Parade (Cresco Crossing). An alternative to removal could also include upgrades or grade separation, which is a more affordable option.
- Tonkin Gap Project (TGP) – MRWA will take up an alliance partner in June 2019 to fast track this project due to a lack of Government funding.

Appendix B: Science of crash force tolerance – vehicle mass and velocity

The mass of a vehicle has an impact on severity outcome in crashes and can be explained using Newton's Second Law of Motion:

(f = ma) or (force = mass x acceleration)

When a constant force acts on a massive body, it causes it to accelerate i.e. to change its velocity at a constant rate. The force acting on an object is equal to the mass of that object multiplied by its acceleration.

The kinetic energy of an object is the energy that it possesses due to its motion. An object that has motion - whether it is vertical or horizontal motion - has kinetic energy. This is the energy that can be transferred into another vehicle or object upon impact in a crash and is expressed as:

(Ek = ½ mv2) or (kinetic energy = ½ mass x velocity2)

Speed increases reaction distance and braking distance & crash forces (d=vt).

Physics – the faster you go the harder you hit! (Ek– speed is quadratic).

Speed has a greater impact on the kinetic energy transfer than mass in the event a vehicle collides with another vehicle or object.

The reaction time of a typical driver, which is the period between a driver detecting a visual stimulus and their physical reaction to it, is 2 seconds.

The faster a vehicle travels, the greater the distance a vehicle will travel in the 2 seconds that it takes for the driver to react.

Distance travelled is calculated by multiplying speed (or velocity) and time, expressed as:

(d = vt) or (distance = velocity x time).

Therefore, the faster a vehicle travels, the less time the driver has to reduce the vehicles speed.

If you refer to the formula for kinetic energy ($Ek = ½mv^2$) you can see that velocity (or speed) is quadratic (or squared).

When comparing the impact of mass and speed on the outcome of a crash, the relationship between kinetic energy and mass is linear, which means that if you double vehicle mass it has twice as much kinetic energy.

The relationship between kinetic energy and velocity is exponential, which means that as you increase your speed, kinetic energy increases dramatically. This highlights that speed has a greater impact on the kinetic energy transfer than mass in the event a vehicle collides with another vehicle or object. It can therefore be argued that due to crash force tolerance, there is a case for reducing road speed in Western Australia. It is important to understand that a blanket approach to reducing speeds may not be appropriate, but rather a more detailed review of the network to understand where this may be required.

Human Tolerance to Violent Forces

A key part of the Safe Systems is accepting that humans will make errors, however infrastructure and the road network should be forgiving. A part of this is understanding the human tolerance to violent process. When designing roads, if conflicts between road users are unavoidable, we need to consider the physical forces within the limits of human tolerance, which is summarised in Figure 3.2. Speed and crash force has an impact on the human body's tolerance towards a violent force. The limits of human tolerance vary between the different types of collision, such as with a vulnerable road user (i.e. cyclists and pedestrians), roadside hazards, side-on collisions or frontal collisions.

Vulnerable Road Users (Pedestrian/Cyclist)

Generally, the human body, without any protection, cannot sustain impacts of above **30 km/h**. To address this, where practical, cyclists and pedestrians should be separated from other road users.

Roadside Hazards

The chances of surviving a fixed-point impact with a roadside hazard such as a tree or a pole decreases rapidly at speeds greater than **40 km/h**.

Side Collision

There is limited protection to the vehicle occupant when there is a side collision and the survivability of a crash significantly reduces above **50 km/h**. Roundabouts may be a good engineering solution to this crash type, as the angle of impact is less severe, and the deflection will reduce travel speed.

Frontal Impact

As the result of improvements of the safety features of vehicles, frontal impacts up to **70 km/h** are generally survivable. Where practical, roads speed zoned above 70 km/h should have separated carriageways, sealed shoulders, audible edge lines and road safety barriers.

Perth's Eastern Region

In Perth's eastern Region, the most common type of crash is a rear end crash. These crashes fit mostly in line with the frontal impact type of crash and are generally survivable. The second most common type of crash is a right-angle, or side collision type of crash. In this instance, roundabouts could be considered as a solution to minimise the impact of these types of crashes.

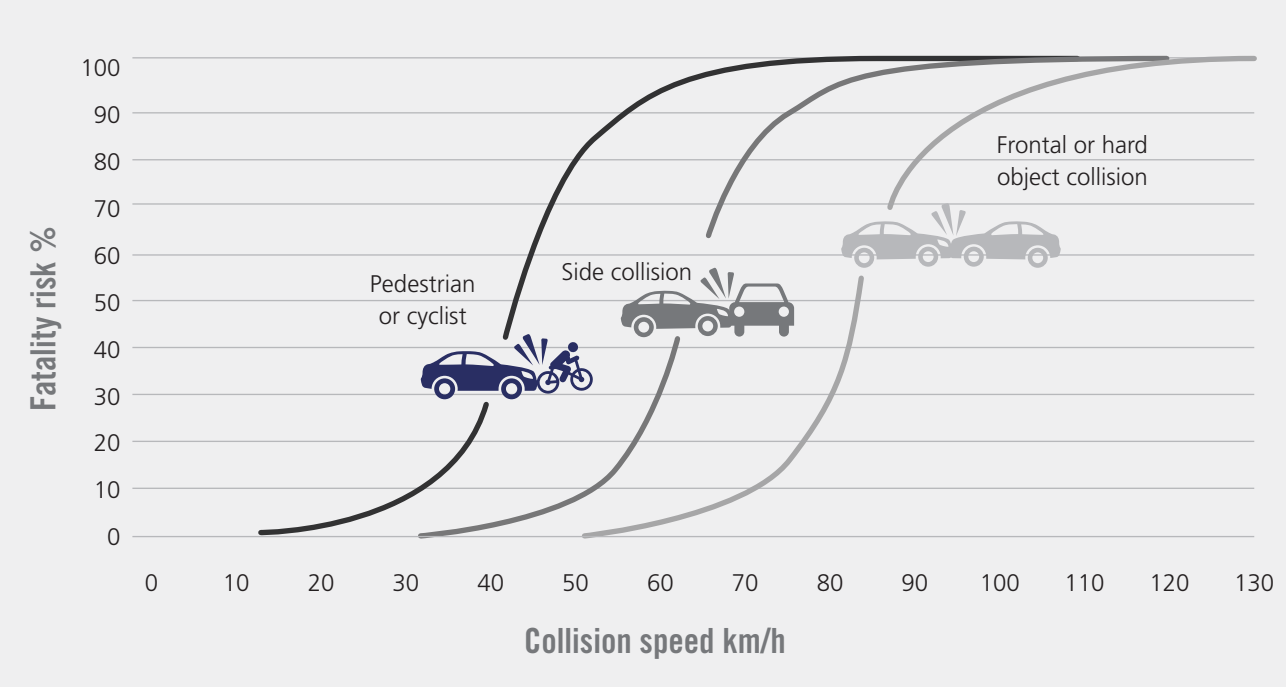


Figure 11.1: Fatality Risk Curve[19]

19 Wrambourg 2005 - https://acrs.org.au/files/arsrpe/full-paper_2019.pdf

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