CRISP
CAPITAL REGION INTERSECTION SAFETY PARTNERSHIP

MONASH University
Accident Research Centre

# EXECUTIVE SUMMARY

March 2013

## An Application of Safe System Approach to Intersections in the Capital Region Progress Report

### Introduction

The Capital Region Intersection Partnership (CRISP) was founded in 2001 by municipalities and other stakeholders to share resources and expertise to reduce the frequency and severity of intersection collisions in the Alberta Capital Region. Its current and targeted aim is to reduce crashes and trauma at intersections through advances in safety performance within the road-transport system.

In January 2012, CRISP engaged the Monash University Accident Research Centre (MUARC) to conduct a practical, evidence-based research project to apply the Safe System road safety philosophy to selected 'poorly performing' intersections in the City of Edmonton, Strathcona County and City of St. Albert (CRISP partner jurisdictions).

MUARC was selected to conduct this study because of its extensive work in intersection safety in Victoria, Australia. In a major study that began in 2008, MUARC defined how intersections should 'look and operate' in order to meet the aspirations of the Safe System approach. This project has now reached the design stage for real-world construction and evaluation of selected intersection designs.

The purpose of this report is to summarise the outcomes of Phase 1 of the CRISP Intersection Project undertaken by MUARC.

### What is Safe System?

The Safe System framework was created in Australia and New Zealand to provide an ethical and practical platform for the design of road-transport systems. It combines the best elements of Sweden's *Vision Zero* and the Netherlands' *Sustainable Safety* road safety philosophies. As a philosophy, Safe System challenges the common belief that death and serious injury are an unavoidable part of road-transport systems. It recognizes that there are limits to the forces that the human body can withstand and seeks to ensure that no road user is subject to forces which will result in death or serious injury. Safe System recognizes that human error is part of the road transport system and while much can be done to reduce human error, it cannot be eliminated.

As an approach to safe intersection design, Safe System focuses both on collision avoidance and mitigating the impact when collisions do occur. It acknowledges both the limits of human capabilities and the limits of human tolerance to violent forces. The goal of Safe System is to eventually eliminate road and transport related death and serious injury.

### The Study

MUARC has taken the same staged approach to the CRISP Intersection Project that it has successfully applied in the Victorian Intersection Project. All relevant and transferable knowledge gained from the Victorian project, including literature review, intersection designs and a tool for estimating the safety level of intersections (KEMM-X model, see below), have been used to inform and conduct the current study.

In Phase 1 of the CRISP Intersection Project (the time frame of this report), the following tasks were completed:

**Task 1:** CRISP analysed crash statistics at local intersections in three partner jurisdictions (City of Edmonton, Strathcona County and City of St. Albert) to rank intersections from most poorly performing to best performing sites.

**Task 2:** Based on the analysis in Task 1, and in consultation with CRISP, MUARC selected five intersections in each jurisdiction that exhibit poor safety performance and three that exhibit good safety performance.

**Task 3:** MUARC conducted a targeted literature review to identify improved, Safe System compliant intersection designs.

**Task 4:** MUARC conducted a workshop in Edmonton with traffic safety stakeholders to generate new intersection designs and review all intersection designs under consideration.

**Task 5:** MUARC assessed the relative risks of the selected intersections in each jurisdiction and a selected number of intersection designs, in terms of their likelihood of preventing death or severe injury in the event of a crash.

**Selection of Intersections (Tasks 1&2)**

The five most poorly performing intersections and three most well performing intersections in each of the City of Edmonton, Strathcona County and City of St. Albert were selected for inclusion in this study. Poorly performing intersections were included to provide a starting point for developing strategies to reduce collision-related trauma. Well performing intersections were included to identify intersections that might already be Safe System compliant.

Each jurisdiction analysed the most recent five-years of collision data (2006-2010) to identify and rank intersections, from the most poorly performing to the most well performing. Based on Safe System thinking, the key variables used to rank intersections were fatality and serious injury causing collisions. The crash types most frequently associated with serious injuries and fatalities were Left-Turn-Across-Path, Right Angle Impacts, as well as Pedestrian and Cyclists Collisions.

From this analysis, and in consultation with MUARC, each jurisdiction confirmed its five most poorly performing and three most well performing intersections (see Tables ES1, ES2 and ES3 below).

**Table ES1: City of Edmonton Selected Intersections**

| Intersection | Control Type | Average Daily Traffic Volume |
|---|---|---|
| ***Poorly Performing*** | | |
| 107 Ave & 142 St | Traffic circle | |
| 118 Ave & 97 St | Traffic signal | 56,478 |
| 129 Ave & 50 St | Traffic signal | 19,814 |
| Princess Elizabeth Ave & 109 St | Traffic signal | 17,773 |
| 82 Ave & 99 St | Traffic signal | 61,543 |
| ***Well Performing*** | | |
| 111 Ave & 156 St | Traffic signal | 54,308 |
| 34 Ave & 99 St | Traffic signal | 54,227 |
| 42 Ave & 106 St | Traffic signal | 17,633 |

**Table ES2: Strathcona County Selected Intersections**

| Intersection | Control Type | Average Daily Traffic Volume |
|---|---|---|
| ***Poorly Performing*** | | |
| Baseline Rd & Broadmoor Blvd | Traffic signal | 51,218 |
| Broadmoor Blvd & Lakeland Dr | Traffic signal | 25,593 |
| Wye Rd & Clover Bar Rd | Traffic signal | 32,845 |
| Wye Rd & Ordze Rd | Traffic signal | 39,635 |
| Wye Rd & Sherwood Dr | Traffic signal | 47,041 |
| ***Well Performing*** | | |
| Baseline Rd & Sherwood Dr | Traffic signal | 56,069 |
| Sherwood Dr & Granada Blvd/Festival Way | Traffic signal | 31,628 |
| Wye Rd & Brentwood Blvd | Traffic signal | 40,160 |

**Table ES3: City of St. Albert Selected Intersections**

| Intersection | Control Type | Average Daily Traffic Volume |
|---|---|---|
| ***Poorly Performing*** | | |
| SAT & Boudreau Rd/ Giroux RD | Traffic signal | 59,790 |
| SAT & Sturgeon Rd / St. Anne St | Traffic signal | 66,717 |
| Bellerose Dr & Inglewood Dr | Traffic signal | 24,453 |
| SAT & Villeneuve Rd/ Erin Ridge Rd | Traffic signal | 35,905 |
| Boudreau Rd & Campbell Rd | Traffic signal | 32,782 |
| ***Well Performing*** | | |
| SAT & St. Vital/ Rivercrest Cr | Traffic signal | 52,086 |
| Boudreau Rd & Erin Ridge Dr/ Inglewood Dr | Traffic signal | 24,892 |
| Grange Dr & Gervais Rd | Traffic signal | 23,031 |

### Safe System Compliant Solutions (Task 3)

For the CRISP Intersection Project, MUARC updated an extensive literature review completed in 2011, as part of the Victorian Intersection Project. The purpose of both reviews was to identify innovative infrastructural measures to improve intersection safety. The literature pointed to both alternative intersection designs and technology as potential solutions.

As alternative designs to traditional signalised intersections, roundabouts, turbo roundabouts and grade-separated interchanges are readily considered as infrastructural interventions. Most 'new' designs proposed in the literature are often variations of these basic designs. These alternative designs emphasize either reducing impact speeds or the number of points of conflict or, alternatively, improving impact angles. Significant emphasis is placed on reduced and enforced lower speeds at junctions, recognizing that speed is fundamental to the outcome of most collisions. Examples include red light cameras, with or without speed cameras, which reduce the number of serious injury collisions at intersections.

Discovery of new and innovative intersection design is tapering. In its place, there is an increased emphasis on technology solutions. Technologies are being developed to enable vehicles to communicate with each other and vulnerable road users, to reduce the likelihood of collision. Gap assist technologies and dynamic/variable signs are showing promise in their ability to reduce intersection speeds. However, most of these technologies are still in their trial phases and unlikely to be widely available in the near future.

For the purposes of this study, Safe System Compliant intersection designs were considered the most likely solutions to reduce crashes and trauma at the poorly performing intersections.

**Safe System Compliant Intersection Designs**

- **Standard Roundabout** – placed at the intersection of two roads and permits one-way travel around a central, circular median to promote lower entry speeds and safer impact angles. Roundabouts are now being widely implemented internationally due to their ability to reduce fatalities greatly as well as their positive environmental impacts.
- **Turbo Roundabout** – placed at the intersection of two roads and has two lanes of traffic per direction, separated by raised or textured islands to physically prevent traffic from changing lanes while traversing the roundabout.
- **Raised Platforms at Intersection** – accompanied by speed reduction signs, provides countermeasures to encourage drivers to adhere to Safe System compliant intersection speeds.
- **Cut-through Signalised Intersection (proposed)** – would allow left turning traffic to proceed similar to a simple intersection while through-traffic proceeds with some deflection and at reduced speeds through a central island, similar to a roundabout. Traffic would be controlled by signals.
- **Squircle (proposed)** – would allow left turning traffic to proceed through the Squircle, while through-traffic would proceed with some deflection created by the presence of islands. It is a more compact version of a cut-through intersection, suitable for urban (downtown) settings, and is also controlled by traffic signals.
- **Grade-Separated Interchange (e.g. overpasses and underpasses)** – separates the two directions of traffic so that the possibility of head-on and angle collisions is eliminated.
- **Reduced Default Speed Limit intersection** – includes a Safe System compliant speed limit (reduced default speed limit of 50 km/h was assumed for this study) that is enforced by red-light speed (speed on green) cameras and prominent signs to inform drivers of the change in speed when traversing the intersection.

See Appendix 2 of full report for images.

**Consideration of Safe System Compliant Intersection Designs (Task 4)**

In April 2012, MUARC conducted a workshop with delegates at Edmonton's *International Conference on Urban Traffic Safety* to discuss existing and identify new, innovative Safe System compliant intersection designs and apply these, conceptually, to the poorly performing intersections selected in Task 2. Workshop participants reinforced the need to apply solutions that produce significant safety impacts rather than incremental improvements. Designs based on the Safe System principles provide opportunity for such improvements. Further discussion is encouraged to explore application of these designs in the Capital region.

## Assessment of Intersection Risk (Task 5)

The energy generated by the motion of vehicles in a collision is directly associated with the risk of serious injury and death. This energy is called kinetic energy. The extent to which kinetic energy is tolerated by both the vehicles (crashworthiness) and people (biomechanical tolerances) involved in a crash can increase or reduce the chance of serious injury and death.

If we could measure the crashworthiness of vehicles and the biomechanical tolerances of people involved in intersection crashes, we could rate the safety level of individual intersections. However, vehicle crashworthiness and human biomechanical tolerances cannot be accurately quantified in real-world situations.

In response, MUARC developed the Kinetic Energy Management Model for Intersections (KEMM-X) to estimate the safety level of individual intersections. KEMM-X uses factors other than crashworthiness or biomechanical tolerances to estimate impact energy. These factors include speed and angle of impact.

In this study, MUARC used KEMM-X to calculate the probability of a fatality and of a serious injury for any given intersection. A fatality value of 0.1 and probability of a serious injury of 0.31 are the thresholds below which an impact may be considered to be Safe System compliant. Calculations were made for collisions at both the posted speed limit and at an enforcement tolerance speed of 15 km/h greater than the posted speed limit. The enforcement tolerance speed demonstrates the increased risk of death and serious injury that is present at higher speeds. It does not assume that all drivers exceed the posted speed limit by this amount.

With the exception of the one traffic circle intersection in this study, most of the signal controlled intersections exceeded these thresholds at the posted speed limit and all exceeded them at an enforcement tolerance speed.

## Conclusions

The tasks completed in Phase 1 of the CRISP Intersection Project show that more can be done to improve intersection safety in the Alberta Capital Region, through the opportunities provided by Safe System philosophy and design principles. Assessment of the poorly performing intersections in each of the City of Edmonton, Strathcona County and City of St. Albert demonstrate that currently posted speed limits, and those which are currently tolerated, are beyond what can be considered Safe System compliant. MUARC suggests that greater attention be given to making intersections within the jurisdictions more forgiving of human error and hence, more in line with the Safe System philosophy.