METHODS OF REDUCING COLLISIONS ON ALBERTA ROADS

USER GUIDE

DRAFT

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ON ALBERTA ROADS

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1.0 INTRODUCTION

Alberta Transportation (TRANS) commissioned Opus International Consultants (Canada) Limited (herein referred to as Opus) to investigate and develop engineering strategies to address the collision patterns on all Alberta highways and streets. These roadways are operated by many different road authorities including urban municipalities, rural municipalities, Counties and the Province. This study, entitled "*Methods of Reducing Collisions on Alberta Roads*" (abbreviated as *MORCOAR*), is intended to help achieve the goals of Alberta Traffic Safety Plan. The study was divided into two phases:

Phase 1: Development of Engineering Strategies and Measures
Phase 2: Development of Application Guidelines and Implementation Strategy

The key study deliverables are as follows:

- Phase 1 Final Report (January 2010)
- Phase 2 Final Report (November 2010)
- "Alberta Road Safety Engineering Toolbox" (searchable database of top 77 measures)

2.0 PURPOSE OF THIS GUIDE

The MORCOAR deliverables are intended for all those involved directly and indirectly in improving traffic safety in Alberta through engineering. This includes but is not restricted to engineers, planners, constructers, administrators, and other decision-makers, in both the public and private sectors.

The purpose of this guide is to introduce the deliverables and tools generated by the MORCOAR project, so that they can be effectively used towards decisions in support of reducing collisions in Alberta over the next several years. Since an abundance of information was provided as part of the project, this guide is intended to direct users to the right documents in a systematic and timely manner.

The various deliverables and tools will be used for different purposes. This document provides specific information on:

- How the study tools relate and link to each other (Section 3);
- How to navigate the database (Section 4); and
- Typical practical applications (Section 5).

3.0 INTRODUCTION TO MORCOAR TOOLS

The MORCOAR tools include:

- Alberta Road Safety Engineering Toolbox (ARSET);
- Basic Application Guidance (in Phase 2 Report);
- Detailed Application Guidance (in Phase 2 Report); and,
- "Toolbox Tables" (in Phase 1 Report).

The deliverables have been prepared such that practitioners can systematically navigate only the materials needed, but be directed to seek more information as required. The tools include more information for the measures that are more effective and require more guidance. The sequence in Figure 1 is suggested (note, slight variations in the sequence are proposed in Section 5.0 depending on the application). In general, users can work backwards, proceeding from the measures themselves to the application guidance to the details of the measures. As much information from the Phase 1 and 2 reports as practically possible was included in the electronic database to maximize the sortability and searchability functions.

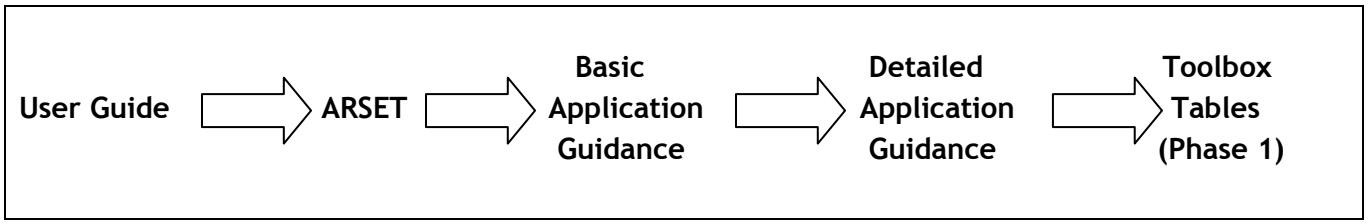

FIGURE 1 SUGGESTED SEQUENCE FOR REVIEW OF MORCOAR TOOLS

For example, for a user who has already identified a measure of interest, such as Gateway Treatments:

1. Use ARSET to learn about the related strategies, benefits and basic context.
2. If it looks relevant, visit the Basic Application Guidance to understand more about its benefits, see a photo, review the land use and speed context, understand the extent of its use in Alberta and typical costs and benefits.
3. If it looks good, but more detail is needed to systematically justify its application, visit the Detailed Application Guidance, which contains several photo examples, concept drawings, descriptions of related studies, and explicit discussion of human factors implications, and some basic implementation guidance.
4. The Toolbox Tables from Phase 1 contain more than 200 strategies and may be used if no appropriate strategies could be found in ARSET.

Some guidance on the selection of the appropriate measure (which would precede the above three steps) is provided in Section 5.0.

4.0 ALBERTA ROAD SAFETY ENGINEERING TOOLBOX (ARSET)

ARSET is a comprehensive database in MS Excel format containing information on the 77 measures considered to be the most applicable for the Alberta context. This includes 33 highly effective measures (HEMs), and 44 other proper measures. Detailed guidance was prepared in this study for 8 of the 33 HEMs. The rows are colour coded to indicate which of these three groups each measure belongs to, and where further information can be viewed.

Red: 'Top 77'

- Only appear in Phase 1;

Yellow: 'Highly Effective'

- Phase 1 and Phase 2 Basic Application Guidelines;

Green: 'Top 8'

- Phase 1, Phase 2 Basic Application Guidelines, and Phase 2 Detailed Application Guidelines

Note that since the 33 highly effective measures were more closely analyzed than the other 44, the database contains additional fields and more information for these measures.

The database fields are defined as follows. More detailed definitions and assumptions are stated in the Phase 1 report.

TABLE 1 DATABASE FIELD DEFINITIONS

DATABASE FIELD NAME	DEFINITION
Countermeasure	Collision reduction measure.
Strategy Type #1	Primary "objective area" as defined by Alberta Transportation (7 possible areas).
Strategy Type #2	Another closely related objective area, due to the inherent "overlap" in multiple objective areas.
Report Location	Location in the Phase 1 or 2 report where more information can be found. (i.e. Phase 2 report location for Highly Effective Measures; Phase 1 report location for other measures).
Application	Very basic application guidance, referring mostly to the measure's objective and applicability to the urban or rural environment.
Collision Reductions Found in Literature	The most relevant collision reduction factors quoted in recent literature, based on robust study, and focused largely on injury and fatality reduction.
MORCOAR Collision Reduction Range	This collision reduction ranges established in this study, based on literature, Alberta considerations and the range in applicable contexts.
Documented Injury/Fatality Reduction	A qualitative assessment of the injury and fatality reduction. Used for ranking purposes.
Human Factors Rating	The performance of the measure from a human factors perspective, based on the criteria developed in this study and documented in the Phase 1 report.
Alberta Applicability Rating	A relative rating of the applicability in the Alberta context, based on criteria developed in this study and documented in the Phase 1 report.
Expected Overall Effectiveness	A combination of the previous three fields. This combined assessment was applied for the identification of the 33 highly effective measures.
Expected Cost-Effectiveness	Considers the relative implementation cost. In addition to the expected overall effectiveness, this was used to identify "Priority 1" measures.
Climate Change Rating	The measure's implications for climate change, which considered.
Source	The key literature sources on which the documented collision reductions are based.

The next two pages show the field entries for the first eight measures in the database, for illustrative purposes.

Countermeasure	Strategy Type #1	Strategy Type #2	Report Location	Strategy Category	Application	Collision Reductions Found in Literature	MORCOAR Collision Reduction Range
30 km/hr School and Playground zones	**Rural and Urban Roadways (Links)**	Speed Related	Phase 1 report: Section 6.4, Table 6.5	School and Playground Zones	urban applications only already implemented in most jurisdictions	60% reduction (all vehicular collisions) 70% reduction (pedestrian and cyclist fatal and injury collisions) More local studies show minimal speed and collision reductions	
Accessible pedestrian signals	**Vulnerable Road Users**		Phase 1 report: Section 6.6, Table 6.7	Traffic Signal Measures	Communicates pedestrian crossing information to the visually impaired	none	
Additional primary signal heads	**Intersection Related (Signalized)**		Phase 1 report: Section 6.2, Table 6.3	Signal Conspicuity Measures	Increases the conspicuity of traffic signals Consider one primary signal head per lane. Revisions to signal support may be required due to increased weight	10% - 25% of fatal and injury collisions 15 - 45% of all angle collisions	
Advance curve warning signs	**Off-road Collisions**	Speed Related	Phase 2 report: Section 2.3 (page 35)	Warning Devices	urban and rural applications signs may include advisory speed tabs and/or flashing beacon	10% reduction (all fatal and injury collisions, sign only) 29% reduction (all head-on collisions, sign only) 30% (all ROR collisions, sign only) 13% reduction (all injury collisions, sign with advisory speed tab) 30% reduction (all collisions, sign with advisory speed tab or flashing beacon)	5% - 13% of all injury collisions
Advance intersection warning flashers	**Intersection Related (Signalized)**		Phase 2 report: Section 2.3 (page 25)	Traffic Operational Measures	AWF are more effective: o where limited sight distances are available o on higher speed roads o at isolated intersections	18% of total collisions 44% of all fatal and injury collisions	20% - 44% of all injury collisions
Conversion of stop-controlled intersections to roundabouts	**Intersection Related (Unsignalized)**	Intersection Related (Signalized)	Phase 2 report: Section 2.3 (page 18)	Traffic Control Measures	Can be implemented in urban and rural environments. Expensive to implement. Should only be implemented at locations where the turning movement volumes are appropriate	18% - 72% of all collisions 72% - 87% of all fatal and injury collisions	57.6% - 69.6% of all fatal and injury collisions

Documented Injury/Fatality Reduction	Human Factors Rating	Alberta Applicability Rating	Expected Overall Effectiveness	Expected Cost Effectiveness	Climate Change Rating	Source
Moderate	Low	Moderate	Moderate	Moderate	Moderate	International Road Safety Engineering Countermeasures and their Applications in the Canadian Context - Page 57
Low	High	High	Low	Low	High	
Moderate	High	High	Moderate	Moderate	Low	G.D. Hamilton Associates Consulting Ltd., Safety Benefits of Additional Primary Signal Heads (1998).
Moderate	Moderate	High	Moderate	High	Moderate	Gan, A., Shan, J. and Rodriguez, A., Update of Florida Crash Reduction Factors and Countermeasures to Improve the Development of District Safety Improvement, Florida Department of Transportation (2005).
High	High	High	High	High	Low	Sayed, T., Homayoun, V., Rodriguez, F., Advance Warning Flashers, Do They Improve Safety? (2000) FHWA, Signalized Intersections: Informational Guide, Report No. FHWA-HRT-04-091 (2004)
High	Moderate	Moderate	High	High	High	National Cooperative Highway Research Program (NCHRP): Roundabouts in the United States, Report 572 (2007)

5.0 USER GUIDANCE FOR TYPICAL PRACTICAL APPLICATIONS

Network Screening

Road agencies often screen their road networks to find:

- Collision patterns that need to be addressed; or
- Opportunities to implement proven measures.

For example, a road agency might have a mandate to reduce pedestrian collisions; then screen the network to find locations with concentrations of pedestrian collisions; then select measures as appropriate. In this instance, the issues associated with the collision patterns should be identified prior to using the MORCOAR tools (note, in the absence of data or identified issues, the "strategy category" in ARSET can be utilized to lead the user to the appropriate measure or measures). Note that MORCOAR is focused on providing solutions, not on problem identification. Problem identification is a critical step in road safety improvement activities. As mentioned, the "strategy category" defined by Opus may imply to some extent the issue that is attempting to be resolved. For example, if signal conspicuity is identified as an issue in a region or at a particular location, then the "signal conspicuity" strategy category can be used to identify applicable measures.

Alternately, an agency may be keen to implement pedestrian countdown signals due to their success in other jurisdictions, and then screen its road network to find suitable locations. In this instance, the user can simply search for this measure in the "countermeasure" column, and then be led to additional information and applicable guidance.

Operational Reviews

However, a more explicit review, based on collision data if possible, is usually required. There are several tools available for this purpose, including the TAC Canadian Guide to In-Service Road Safety Reviews, the AASHTO Highway Safety Manual, and collision prediction models that have been developed or adopted by local road agencies.

Examples of common issues and collision patterns associated with each of the objective areas are summarized in TABLE 2. This table is intended to provide general guidance and is *not* exhaustive.

TABLE 2 COMMON ISSUES AND COLLISION PATTERNS FOR EACH OBJECTIVE AREA

Objective Area	Common Safety Issues	Related Collision Patterns/Types
Speed Related Collisions	• Wide roadways • Improper Speed Limits • Driver aggression, distraction • Inadequate adjustment/transition	• Rear-end collisions • Sideswipe collisions • Collisions during low-volume, dark conditions • Run-off-road collisions
Collisions at Unsignalized Intersections	• Failure to see stop sign • Incorrect traffic control • Failure to accept an adequate gap • Inadequate warning • Sight distance/glare	• Right-angle collisions • Left-turn crossing collisions • High severity collisions
Collisions at Signalized Intersections	• Lane configuration • Inadequate signal conspicuity • Signal phasing / timing	• All multi-vehicle collision types
Vehicle-Wildlife Collisions	• Inadequate fencing • Inadequate warning	• Collisions in dark conditions • Run-off-road collisions • Seasonal collision patterns
Collisions Along Roadways (Links)	• Improper delineation • Road surface issues • Passing opportunities	• Rear-end collisions • Speed-related collisions • Head-on collisions
Run-Off-Road Collisions	• Unsafe speeding • Improper delineation • Design inconsistency • Fatigue • Roadside hazards	• Single-vehicle collisions • Overturning collisions • Secondary collisions • Collisions in winter
Collisions Involving Vulnerable Road Users	• Lack of adequate facilities • Insufficient illumination • Intersection traffic control • Jaywalking	• Collisions in dark conditions • Fatal collisions in urban areas • Off-road collisions

For example; an urban signalized intersection with positive offset left-turn lanes is still experiencing numerous collisions due to left turning vehicles proceeding when it is unsafe (left-turn across path collisions).

Use ARSET first to view all signalized intersection collisions (use the drop down menu in cell C1, and select 'Intersection Related (Signalized)'). From this list of 13 strategies, there are

5 strategies identified as 'Top 77' (red cells), 6 as 'Highly Effective' (yellow), and 2 as 'Top 8' (green).

Review the green strategies first to see if any apply to this situation. The two strategies are positive offset left-turn lanes and protected only left-turn phase. Since positive offset left-turn lanes were already applied, protected only left-turn phase should be considered. Review the information provided to determine if this strategy is applicable.

Row E of ARSET indicates the location in the Phase 2 report where the strategy is summarized (Section 2.3 (Basic Applications), Page 29). Page 29 provides a summary of the strategy, and indicates other locations to find additional information (including the Detailed Application section of the Phase 2 report (Section 3.5). After reviewing the one page summary the strategy still seems appropriate, the detailed application guidelines should be reviewed.

Note the above step may be skipped by looking up the Detailed Application directly for Protected Only Left-turn Phases in the Phase 2 table of contents (evident from the green cells in ARSET).

After reviewing the detailed application guidelines, if the strategy still seems appropriate, the strategy may be considered. If for some reason the strategy does not seem applicable, the 'Top 77' sources (red cells in ARSET) may be reviewed.

Planning and Design

MORCOAR tools can also be used in planning and design. Planners and designers should build in as many of the highly effective measures as possible. For example, at a new signalized intersection, measures such as left-turn phasing, signal back plates and pedestrian countdown signals should be implemented, unless there are exceptional circumstances. A similar approach can be taken during retrofit situations: to incorporate as many of the high effective measures as is practicable.

At the planning and design stages, the context-sensitive guidance prepare for this study is particularly valuable, since a collision history may not be established. In addition, the collision reduction factors (CRFs) and the benefit-cost information can provide a good assessment of the available options and their associated benefits.

5.0 CONCLUSION

If further guidance is required, the consultant or steering committee member can be contacted.

The extensive and appropriate use of the MORCOAR tools are strongly encouraged, and expected to reduce traffic collisions in Alberta and other jurisdictions.

Government of Alberta
Transportation