

Government of Alberta ■ Transportation	SAFETY MEASURES AT RURAL STOP-CONTROLLED INTERSECTIONS		<i>Issued: MAY 2004</i>
			<i>Revised: DEC 2006 OCT 2010 SEP 2011</i>
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General

Maintaining safe operation of rural intersections is a high priority in the overall operation of the provincial highways.

Over the years, strategies and warrants have been developed to deal with rural stop-controlled intersections which pose safety concerns.

The guiding principles for developing these strategies and warrants have been that the potential for collisions can be reduced through the application of adequate traffic control devices and safety measures.

Before warrants can be applied at a specific location, a comprehensive engineering study must be conducted, including a safety investigation and an evaluation of intersection operational characteristics.

A brief overview of the principle components of conducting an engineering study is provided in this guideline.

The Hierarchical System

A hierarchical system of signing, markings and other supplementary devices has been developed to treat a range of operational conditions at stop-controlled intersections with safety problems.

The system allows for the application of four levels of traffic control devices through the use of warrants. The warrants consider traffic volumes, collision history, minimum or substandard intersection geometry, environmental factors and the presence of other traffic control devices.

At the fundamental level, there is a do-nothing alternative, and it may be the most practical alternative in certain cases.

Standardization

Traffic control devices should be implemented in a consistent manner to ensure their effectiveness and appropriate road-user response.

More specific guidance comes from the Manual of Uniform Traffic Control Devices for Canada (MUTCDC), which not only advocates a consistent use of the traffic control devices across each province, but also cautions against overuse of regulatory and warning traffic devices.

Overuse of traffic control devices may cause their reduced effectiveness.

The basic strategy is to establish a priority listing of troublesome locations in a region or district. Locations which exhibit similar safety or operational problems can then be treated with a comparable traffic control scheme.

Operation of traffic control devices must be continually monitored so that devices remain effective and available funding derives the best value.

Assessment of Situation

In determining which traffic control devices and traffic control scheme are the most suitable for a particular intersection, a number of factors should be considered.

These include:

- Collision history, including: number and type of accidents, accident severity, accident-contributing factors and environmental conditions.
- Traffic characteristics, including: traffic volumes and distribution of vehicle types, running and posted speeds, and vehicle delays.
- Roadway characteristics, including: vertical and horizontal elements, intersection configuration and sight distances, roadway classification and function.
- Existing traffic control devices, including: signing, pavement markings and if present, other control devices.

Assessment of site characteristics and the development of safety measures for a problematic rural stop-controlled intersection are accomplished through an engineering study.

Normally, such a study will involve a safety investigation, accident analysis, field assessment, operational analysis and geometric assessment.

Examples of such studies are Safety and Operational Assessments conducted by Alberta Transportation at locations which pose operational and safety problems.

The intent of the studies is to identify safety concerns and deficiencies at problematic locations and to provide recommendations on how to improve these deficiencies.

These improvements may range from full reconstruction to the application of a single traffic control device.

The following departmental sources provide information about a given location:

- Alberta Transportation's website provides information on traffic characteristics (volumes, distribution) and geometric characteristics (a GPS record of the roadway vertical and horizontal alignment).
- Highway plan-profiles and intersection plans.
- Videolog data for roadway sections.
- Inventory of roadway appurtenances.

The following provincial and national sources are recommended for use during an assessment project:

- Design Bulletins.
- Highway Geometric Design Guide (*available on the Alberta Transportation website*)
- Highway Pavement Marking Guide (*available on the Alberta Transportation website*)
- Recommended Practices (*available on the Alberta Transportation website*)
- Typical Signage Drawings (*available on the Alberta Transportation website*)
- Sign Catalogue (*available on the Alberta Transportation website*)
- Manual of Uniform Traffic Control Devices for Canada (MUTCDC) (*hard copies are available from the Transportation Association of Canada*)

A comprehensive set of guidelines for conducting an engineering study to assess safety and operational problems at a given location has recently been published by the Transportation Association of Canada.

The document is entitled *Guide to In-Service Road Safety Reviews* and is an excellent source to be used in conjunction with the provincial manuals and guides.

Four-Level System of Safety Measures

(A Four-Level System of Traffic Control Devices to be used at Rural Stop-Controlled Intersections)

If it is determined through an engineering study that an intersection has safety or operational problems, the next step is to define appropriate safety measures.

The following four warrants identify the criteria for supplementary traffic control devices at a problematic stop-controlled intersection. The warrants consider four levels of traffic control devices for a different range of operational conditions.

Level 1 – Warrant For Use of Oversize Stop sign

The warrant for the use of an Oversize Stop sign represents the first level of safety enhancement at a stop-controlled intersection. Such an enhancement is typically needed at locations where operational or geometric problems create a potential for collisions involving Stop sign violation (e.g., high operating speeds, or reduced visibility on an approach).

The enhanced version of a Stop sign has three sizes: 900 mm x 900 mm, 1200 mm x 1200 mm and 1500 mm x 1500 mm. The

signs are used in various situations depending on the intended degree of emphasis.

The following paragraphs include a set of three warrants for the application of the three types of an oversize Stop sign.

The same set of warrants, together with more detailed guidelines on the use of a standard and oversize Stop sign, have been included in the Recommended Practices guideline entitled Stop Sign.

The intent of including the warrants in this guideline is to provide a complete overview of all safety measures commonly used at rural stop-controlled intersections in Alberta.

This will enable a traffic operations engineer to better assess intersection conditions at a given location and make a better decision.

The following warrant may be utilized when deciding when to use a **900 mm x 900 mm** Stop sign.

- A 900 mm x 900 mm Stop sign may be used at a major or a minor rural intersection when one of the following conditions is present:
 - a history exists of three or more collisions or reported incidents (near misses) involving Stop sign violation over a period of five years
 - an intersection has reduced visibility along a stop-controlled approach due to vertical or horizontal alignment constraints
 - an approach to a stop-controlled intersection is located in a complex visual environment, such as along urban or semi-urban roadways. In such environments, many signs compete for the drivers' attention

and as a result drivers may become easily distracted and may fail to notice an upcoming Stop sign

- an intersection features complex and frequent turning maneuvers, forcing a driver to concentrate more on a driving task.

An oversize 900 mm x 900 mm Stop sign should also be considered along approaches to all major intersections along provincial two-lane highways posted at 100 km/h, and major intersections on rural multilane undivided and divided highways.

Installation of an oversize **1200 mm x 1200 mm or 1500 mm x 1500 mm** Stop sign may be warranted when both of the following conditions are present:

- an intersection has been identified as a high collision location with three or more accidents involving Stop sign violations over the period of five years
- other safety measures, such as improving sight lines or installing oversize 900 mm x 900 mm signs, have already been tried and have proven ineffective.

A **1500 mm x 1500 mm** Stop sign should only be considered on an exceptional basis at major problematic intersections of high volume, high speed provincial highways.

Level 2 – Warrant For Stop Ahead sign

Installation of a Stop Ahead sign introduces a second level of safety enhancement at an intersection. This measure is normally introduced when drivers fail to respond to an upcoming stop condition.

A Stop Ahead sign may be installed when one of the following conditions is present:

- visibility problems exist due to sight distance restrictions on the approaches
- roadway alignment rapidly changes and, as a result, drivers focus their attention on adjusting to the roadway environment rather than on the upcoming junction
- complex visual environments in semi-urban or urban areas
- a previously implemented oversize Stop sign has proven to be ineffective

Level 3 – Warrant For Supplementary Pavement Markings

Supplementary pavement markings include word markings such as Stop and Stop Ahead.

Stop and Stop Ahead word markings may be used as an enhancement to the existing regulatory or warning devices (such as an oversize Stop sign and Stop Ahead sign) at locations where there is a high potential for collisions due to difficult roadway geometric or operational conditions.

Stop word markings may be installed at intersections where all of the following conditions are present:

- a history exists of three or more collisions involving Stop sign violation over a period of five years
- an approaching roadway is posted at 80 km/h or higher
- traffic volumes on an approach exceed 500 vehicles per day
- other safety measures such as an oversize Stop sign and Stop Ahead sign have been tried and have proven to be

ineffective in eliminating Failing to Stop collisions.

Stop Ahead word marking may be installed at intersections where Stop markings have been used and a Stop Ahead warning sign is present.

Stop Ahead markings are suitable for approaches with reduced visibility due to sharp horizontal curves, steep uphill grades with sharp vertical curves or other roadway conditions which may cause sight distance restrictions.

More detailed guidelines on the application of Stop and Stop Ahead word markings are provided in the Highway Pavement Marking Guide.

Level 4 – Warrant For Installing Flashing Red Lights

Flashing red lights (i.e., beacons) represent the highest level of safety enhancement to warning devices used at stop-controlled intersections. Flashing red lights should only be considered when their installation will result in a significant safety improvement.

The public often perceives that flashing red lights provide a solution to a wide range of real and perceived problems. Requests for flashing red lights from the public and local officials need to be assessed realistically with the use of warrants and guidelines.

To maintain credibility, to ensure overall device effectiveness, and to maintain uniformity on a province-wide basis, flashing red lights should be restricted to sites which meet the criteria specified under the following warrant.

Operational Warrant

Flashing red lights may be warranted when all of the following conditions are met:

- an intersection has a history of three or more collisions involving Stop sign violation over a period of five years and has been classified as a special monitoring location
- an approaching roadway carries traffic volumes of 500 AADT or more. Usually, it is not cost effective to install flashing beacons at intersections with highways carrying lower traffic volumes (i.e., the potential for collisions under low traffic conditions is usually lower as well)
- a posted speed along the approaching roadway, where the flashing lights appear, is 80 km/h or more
- other safety measures, such as an oversize Stop sign, a Stop Ahead sign, and word markings have proven to be ineffective in eliminating Failing to Stop collisions.

The above safety measures are designed only for approaches to rural problematic stop-controlled intersections.

Use of Traffic Control Devices along a Major Highway

The public often perceives that safety at an intersection can be further enhanced by applying traffic control devices along a major highway in advance of an intersection. In Alberta, there is a general strategy to maintain an uninterrupted flow along a major highway. Traffic control devices are supplemented by warning signs or devices only when absolutely necessary.

Important Intersection Ahead Sign

Under special circumstances, an Important Intersection Ahead sign may be introduced along a highway in advance of a major intersection.

The sign informs drivers to exercise caution when entering an intersection with complex geometry (e.g., to be ready to enter a proper turning lane or navigate safely through lanes with concrete islands).

The Important Intersection Ahead sign is not intended as a measure to slow down vehicles along a major highway and should never be used on the approaches to Stop-controlled intersections.

A detailed set of guidelines on the application of Important Intersection Ahead sign can be found in the Recommended Practices guideline entitled Important Intersection Ahead sign.

Concealed Road Sign

When a problematic intersection is hidden to the approaching traffic, the Concealed Road sign may alleviate some of the operational and safety problems. A Concealed Road sign is appropriate when there are sight distance restrictions and *Entering when Unsafe* collisions are frequent. Detailed guidelines appear in the Recommended Practices guideline entitled Concealed Road sign.

Review of Traffic Control Scheme

Under certain traffic and operational conditions, a rural two-way stop-controlled intersection may be a candidate for a traffic control review and a Four-Way Stop control scheme. Such conditions are rare and

require a separate review in accordance with the guidelines for four-way stop-controlled intersections.

A detailed overview of a warrant and guidelines for application of four-way stop control can be found in the Recommended Practices guideline entitled Stop sign.

Assessment of the Need for Traffic Signals

Some rural stop-controlled intersections carrying very high traffic volumes and experiencing frequent Stop sign violations may qualify for traffic signals. Such conditions require a separate review and a traffic signal warrant assessment.

More information on the traffic signal warrant assessment can be found in the Transportation Association of Canada's *Traffic Signal Warrant Handbook*.

Alternative Safety Measures

It is important to realize that not all situations can be solved with the use of traffic control devices. Other hazard mitigation measures or improvements may prove to be more cost-effective as long term solutions.

These measures include:

- improvements to sight distances (e.g., clearing bush or trees)
- improvements to road geometry (e.g., flattening a horizontal curve)
- providing roadway lighting.

Normally, the type, extent and cost-effectiveness of these improvements are determined through roadway planning and economic analysis.

References to Standards

Recommended Practices	Stop Sign Important Intersection Ahead Sign Concealed Road Sign
Highway Geometric Design Guide Chapter D	At Grade Intersections
Highway Pavement Marking Guide Section C4 Section C5	Symbol and Word Markings Intersection Markings
Manual of Uniform Traffic Control Devices for Canada Part B	Traffic Control Signals
Transportation Association of Canada	Traffic Signal Warrant Handbook