Relationship with Austroads Guide to Road Design – Part 6 (2010)


When reference is made to other parts of the Austroads Guide to Road Design series (Road Design or Traffic Management), the reader should also refer to Transport and Main Roads related manuals:

- Road Planning and Design Manual

Where a section does not appear in the body of this supplement, the Austroads Guide to Road Design – Part 6 criteria is accepted unamended.

This supplement:

- has precedence over the Austroads Guide to Road Design – Part 6 when applied in Queensland
- details additional requirements, including accepted with amendments (additions or differences), new or not accepted
- has the same structure (section numbering, headings and contents) as Austroads Guide to Road Design – Part 6.

The following table summarises the relationship between the Austroads Guide to Road Design – Part 6 and this supplement using the following criteria:

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<th>Section</th>
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<td>Part or all of the section has been accepted with additions and or differences.</td>
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<tr>
<td>1 Introduction</td>
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<tr>
<td>1.1 Purpose</td>
<td>Accepted with amendments</td>
</tr>
<tr>
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<tr>
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</tr>
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<tr>
<td>2.2 Roadside facilities and infrastructure</td>
<td>Accepted</td>
</tr>
<tr>
<td>3 Designing for safety</td>
<td></td>
</tr>
<tr>
<td>3.1 General</td>
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<tr>
<td>3.2 A safe road environment</td>
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### 3 Designing for safety

<table>
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<th>3.3</th>
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<td>Design to keep vehicles on the road</td>
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</table>

### 4 Design to mitigate hazards

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<tr>
<th>4.1</th>
<th>Hazard mitigation process</th>
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<tr>
<td>4.2</td>
<td>Design Step D1: Determine area of interest</td>
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<td>Design Step D2: Identify hazards</td>
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<td>4.6</td>
<td>Hazard risk assessment</td>
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<td>Design Step D6: Design the roadside treatments</td>
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### 5 Treatment options

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<th>5.1</th>
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<tr>
<td>5.2</td>
<td>Summary of treatment options</td>
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</tr>
<tr>
<td>5.3</td>
<td>Effectiveness of treatment options</td>
<td>Accepted with amendments</td>
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<td>Types of treatments</td>
<td>Accepted with amendments</td>
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### 6 Road safety barriers

<table>
<thead>
<tr>
<th>6.1</th>
<th>Introduction</th>
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<tbody>
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<td>6.2</td>
<td>Factors considered in barrier selection</td>
<td>Accepted with amendments</td>
</tr>
<tr>
<td>6.3</td>
<td>Road safety barrier design process</td>
<td>Accepted with amendments</td>
</tr>
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<td>6.4</td>
<td>General access through road safety barriers</td>
<td>Accepted with amendments</td>
</tr>
<tr>
<td>6.5</td>
<td>Road safety barriers for vulnerable road users</td>
<td>Accepted with amendments</td>
</tr>
<tr>
<td>6.6</td>
<td>Aesthetic road safety barriers</td>
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<td>6.7</td>
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<td>6.9</td>
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### 7 Design for steep downgrades

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<th>7.1</th>
<th>Purpose and need</th>
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</tr>
</thead>
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<tr>
<td>7.2</td>
<td>Containment facilities</td>
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</tr>
<tr>
<td>7.3</td>
<td>Warrant for investigation</td>
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<td>7.4</td>
<td>Location and spacing</td>
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<td>Design process</td>
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### References

| References | Accepted with amendments |

### Appendices

<table>
<thead>
<tr>
<th>Appendix A</th>
<th>Terminology</th>
<th>Accepted with amendments</th>
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<tr>
<td>Appendix B</td>
<td>Hazard mitigation worksheet</td>
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<td>Appendix C</td>
<td>RTA method</td>
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</tr>
<tr>
<td>Appendix D</td>
<td>Examples of clear zone calculations</td>
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### Appendices

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
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</thead>
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<tr>
<td>Appendix E</td>
<td>Severity indices tables</td>
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<tr>
<td>Appendix F</td>
<td>Example of manual calculation of run-off road crash numbers and costs</td>
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<td>RISC method and process</td>
<td>Accepted with amendments</td>
</tr>
<tr>
<td>Appendix H</td>
<td>Treatments for brownfield sites</td>
<td>Accepted with amendments</td>
</tr>
<tr>
<td>Appendix I</td>
<td>Examples of length of need calculations</td>
<td>Accepted with amendments</td>
</tr>
<tr>
<td>Appendix J</td>
<td>Types of safety barrier terminals</td>
<td>Accepted with amendments</td>
</tr>
<tr>
<td>Appendix K</td>
<td>Transitions between barrier types</td>
<td>Accepted with amendments</td>
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<td>Barriers at intersections</td>
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### Commentaries

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<td>Commentary 15</td>
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</table>
Contents

1 Introduction .............................................................................................................................................1
  1.1 Purpose .........................................................................................................................................1
  1.2 Scope of this part ......................................................................................................................... 1
  1.4 Terminology ............................................................................................................................... 2
3 Designing for safety ..............................................................................................................................2
  3.1 General ........................................................................................................................................2
4 Design to mitigate hazards ..................................................................................................................2
  4.1 Hazard mitigation process ............................................................................................................ 2
  4.2 Design Step D1: Determine area of interest ................................................................................ 2
    4.2.1 General .................................................................................................................................. 2
    4.2.2 Determine the clear zone ....................................................................................................... 2
    4.3.2 Types of hazard ....................................................................................................................... 6
    4.3.3 Embankment warrant for high-speed roads .......................................................................... 6
    4.3.4 Embankment assessment process ........................................................................................ 6
    4.3.5 High-consequence hazards .................................................................................................. 7
    4.3.6 Generalised hazard assessment process ............................................................................... 7
    4.3.7 Median assessment process .................................................................................................. 11
    4.5.4 Methods for quantitative analysis ......................................................................................... 12
    4.5.5 Simple manual method ......................................................................................................... 12
    4.5.6 Detailed manual method ........................................................................................................ 13
    4.5.7 Roadside impact severity calculator ..................................................................................... 13
    4.5.8 Roadside safety analysis program ......................................................................................... 13
    4.5.9 Alternative crash risk method ............................................................................................. 13
    4.5.10 Low volume roads with a consistent roadside environment ................................................ 14
    4.6.1 General .................................................................................................................................. 14
    4.6.4 Risk Step R3 – Calculate crash cost for hazard ................................................................. 14
  4.8 Design Step D6: Design the roadside treatments .......................................................................... 14
5 Treatment options ................................................................................................................................15
  5.3 Effectiveness of treatment options ............................................................................................... 15
  5.4 Types of treatments ....................................................................................................................... 15
    5.4.1 Treatments for trees ............................................................................................................... 15
    5.4.4 Treatments for verges ........................................................................................................... 15
    5.4.5 Treatments for drains ........................................................................................................... 15
    5.4.6 Treatments for drainage features ........................................................................................ 15
    5.4.13 Treatments for poles ........................................................................................................... 16
6 Road safety barriers .............................................................................................................................17
  6.1.2 General requirements for road safety barrier systems ............................................................ 17
  6.2.1 Site conditions .......................................................................................................................... 18
  6.3.3 Step B2 – Determine the objectives of the safety barrier ....................................................... 19
  6.3.4 Step B3 - Determine the lateral position of the barrier ............................................................ 19
  6.3.5 Offset to travel lane ................................................................................................................ 19
  6.3.6 Support width .......................................................................................................................... 20
  6.3.9 Barrier location in medians ...................................................................................................... 21
  6.3.11 Wider medians ....................................................................................................................... 21
  6.3.13 Step B5 – Determine the barrier containment level required ............................................... 21
  6.3.14 Step B6 – Choose the barrier type ........................................................................................ 22
  6.3.15 Step B7 – Determine dynamic deflection .......................................................................... 24
  6.3.16 Step B8 – Determine vehicle roll allowance and system width ......................................... 24
  6.3.17 Step B9 – Determine the working width .............................................................................. 25
Figures

Figure 6-1 - Clear zone depiction (extracted from Figure 3.1 (AASHTO 1996)) ......................................... 4
Figure 6-2 - Clear zone concept on recoverable and non-recoverable slopes ......................................... 6
Figure 6-3 - Generalised hazard assessment process ..................................................................................... 10
Figure 6-4 - Median barrier warrants assessment guideline ............................................................................. 12
Figure 6-5 - Equations and set-out method for Length of Need – Part 1 of 3 .............................................. 26
Figure 6-6 - Equations and set-out method for Length of Need – Part 2 of 3 .............................................. 27
Figure 6-7 - Equations and set-out method for Length of Need – Part 3 of 3 .............................................. 28
1 Introduction

1.1 Purpose

The purpose of this Volume 3, Part 6 is to reduce the frequency and severity of crashes by providing guidance in identifying and prioritising existing and potential roadside hazards for treatment using quantitative risk analysis, benefit/cost techniques and qualitative evaluation. Using this guideline, together with engineering judgment, provides a rational approach to providing safety barrier installation, in a manner that will maximise the benefits to the community.

A site specific risk assessment incorporating engineering judgement is required for all designs. Criteria and procedures outlined in this part are not a substitute for, but can assist engineering judgement. The unique circumstances of each location and the amount of funds available for road improvement must be considered when treating roadside hazards.

This part is to be applied to the road network for all new construction and the existing road network when hazards are identified, or when existing facilities are upgraded and/or maintained.

1.2 Scope of this part

This document is not strictly limited to assessment of hazards entirely within the road corridor, as, based on a site specific risk assessment there may be instances where an engineer may need to consider what is outside the road corridor.

This document contains additional scope, as provided in Table 6-1 below.

Table 6-1 – Scope items in this Road Planning and Design Manual in addition to Austroads Guide to Road Design – Part 6.

<table>
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<td>Section 4.3.6</td>
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<td>Section 4.3.7</td>
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<td>Temporary Road Safety Barriers</td>
<td>Section 6.8</td>
</tr>
<tr>
<td>Road Safety Barrier Retrofit</td>
<td>Section 6.9</td>
</tr>
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| Design Criteria for Bridges and other structures including:  
  - Protection for bridges and other structures  
  - Protection of overhead gantries | Transport and Main Roads Design Criteria for Bridges and Other Structures. |
| Protection for Railway Corridors | Transport and Main Roads Design and Selection Criteria for Road/Rail Interface Barriers. |
1.4 Terminology

**Differences**

In instances of conflict, definitions in the *Road Planning and Design Manual* take precedence over definitions in the *Austroads Guide to Road Design*.

3 Designing for safety

3.1 General

**Additions**

Refer to the Transport and Main Roads *Guidelines for Road Design on Brownfield Sites* document and Appendix H in this document for guidelines on brownfield sites.

4 Design to mitigate hazards

4.1 Hazard mitigation process

**Differences**

Step 6 of the Hazard Mitigation Process is reworded to: “Step 6: Design any recommended roadside treatments”.

**Additions**

Transport and Main Roads policy on the Hazard Mitigation Process provides the option of not installing roadside treatments to mitigate hazards if there are no engineering and/or fiscal warrants for the roadside treatment. Warrants for roadside treatments include satisfying an appropriate Benefit/Cost Ratio (BCR) for any proposed roadside treatment. Refer to Section 4.3.6.

4.2 Design Step D1: Determine area of interest

4.2.1 General

**Differences**

The contents of Section 4.2.1 of the *Austroads Guide to Road Design – Part 6* have no relevance to the purpose of Design Step D1, being the identification of an area of interest. Furthermore, ensuring a good condition of a road (e.g. in terms of geometry or maintenance) is not a prerequisite to the identification and assessment of hazards.

4.2.2 Determine the clear zone

**Additions**

*What is a clear zone?*

If a roadside feature lies within the clear zone for a particular road segment, there is an increased probability of a collision. This probability increases as the clearance from the running lanes to the feature is reduced.

The concept of the clear zone is best depicted by Figure 6-1 through a review of Annual Average Daily Traffic (AADT) and distance-to-hazard considerations.
Considerations in applying clear zones to designs

While the text in this section of the Austroads Guide to Road Design – Part 6 may be used for guidance, the concept of clear zone is not absolute. Given this point Austroads Guide to Road Design – Part 6, Figures 4.2 and 4.3 do describe how the clear zone is measured.

Clear zone width was developed for and is applicable to relatively straight sections of road for all angles of departure. An adjustment factor is used at curves where the departures angles are increased.

Despite the statements in the Austroads Guide to Road Design – Part 6, there is no specific definition available for what constitutes an ‘errant vehicle’. The department disagrees with the statement ‘It should be noted that a vehicle that crosses the centre line or median into the opposite carriageway is an errant vehicle’ as, for example, a legal overtaking manoeuvre cannot be considered errant. A full or comprehensive definition of ‘errant vehicle’ is not being provided in this document but it should be assumed that an errant vehicle is one which, in part, has a degree of not being under control by the operator.

Differences

Clear zone width

The Austroads Guide to Road Design – Part 6 method of determining clear zone width is not accepted as it is different to the traditional method adopted by the department that is itself an adoption of the AASHTO guidelines.

It is important to note that clear zone guideline numbers are a general approximation, and the designer must keep in mind site specific conditions, design speeds, rural versus urban locations and practicality.

Table 4.1 in Section 4.2.2 of the Austroads Guide to Road Design – Part 6 is not accepted because it greatly simplifies the clear zone philosophy and also leads to consistently more conservative outcomes for each specific site; but it may be used for guidance.

Table 4.2 in Section 4.2.2 of the Austroads Guide to Road Design – Part 6 is accepted.

Clear zone width was not originally intended to be represented by a fixed number. Consequently the department’s methodology is better described by a range of values. Therefore, in all cases, the clear zone width adopted for any design is based on engineering judgement. Clear zone width is to be guided by:

- Firstly, Figure 6-1 which is extracted from Figure 3.1 of AASHTO Roadside Design Guide (AASHTO 1996).
- Secondly, Table 6-2 which is extracted from Table 3.1 of AASHTO Roadside Design Guide (AASHTO 2011).
Figure 6-1 - Clear zone depiction (extracted from Figure 3.1 (AASHTO 1996))
Table 6-2 - Clear zone table (extract from Table 3-1 (AASHTO 2011))

Table 3-1. Suggested Clear-Zone Distances in Meters (Feet) from Edge of Through Travelled Lane (6)

<table>
<thead>
<tr>
<th>Design Speed (km/h)</th>
<th>Design ADT</th>
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<th>Back Slopes</th>
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<tr>
<td></td>
<td></td>
<td>1V:6H or flatter</td>
<td>1V:6H to 1V:4H</td>
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<tr>
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<td>UNDER 750</td>
<td>2.0-3.0</td>
<td>2.0-3.0</td>
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<tr>
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<td>750-1500</td>
<td>3.0-3.5</td>
<td>3.5-4.5</td>
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<tr>
<td></td>
<td>1500-6000</td>
<td>4.5-6.0</td>
<td>5.0-8.5</td>
</tr>
<tr>
<td></td>
<td>OVER 6000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70-80</td>
<td>UNDER 750</td>
<td>3.0-3.5</td>
<td>3.5-4.5</td>
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<td></td>
<td>OVER 6000</td>
<td>9.0-10.5</td>
<td>11.5-14.0</td>
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Notes:

a) When a site-specific investigation indicates a high probability of continuing crashes or when such occurrences are indicated by crash history, the designer may provide clear-zone distances greater than the clear zone shown in Table 3-1. Clear zones may be limited to 9 m for practically and to provide a consistent roadway template if previous experience with similar projects or designs indicates satisfactory performance.

b) Because recovery is less likely on the unshaded, traversable 1V:3H foreslope on a fill section, fixed objects should not be present in the vicinity of the toe of these slopes. Recovery of high-speed vehicles that encompass beyond the edge of the shoulder may be expected to occur beyond the toe of slope. Determination of the width of the recovery area at the toe of slope should consider right-of-way availability, environmental concerns, economic factors, safety needs, and crash histories. Also, the distance between the edge of the through traveled lane and the beginning of the 1V:3H slope should influence the recovery area provided at the toe of slope. While the application may be limited by several factors, the foreslope parameters that may enter into determining a maximum desirable recovery area are illustrated in Figure 3-2. A 3-m recovery area at the toe of slope should be provided for all traversable, non-recoverable fill slopes.

c) For roadways with low volumes, it may be practical to apply even the minimum values found in Table 3-1. Refer to Chapter 12 for additional considerations for low-volume roadways and Chapter 10 for additional guidance for urban applications.

d) When design speeds are greater than the values provided, the designer may provide clear-zone distances greater than those shown in Table 3-1.

Effect of embankment slope

Figure 4.4(b) in Section 4.2.2 of the Austroads Guide to Road Design – Part 6 contains an error. Correctly, the non-recoverable slope commences at the hinge point and the verge contributes to the clear zone distance as shown in Figure 6-2. A non-recoverable slope does not contribute to the clear zone measurement, whereas a recoverable slope does.

Figure 4.4 in Section 4.2.2 of the Austroads Guide to Road Design – Part 6 is replaced with Figure 6-2.
4.3.2 Types of hazard

Additions

Refer also to Transport and Main Roads Design Guide for Roadside Signs for Queensland specific definitions of non-hazardous fixed objects.

Noise barriers are hazards. Refer to Transport and Main Roads Transport Noise Management Code of Practice for guidance on integrated design of noise barriers.

4.3.3 Embankment warrant for high-speed roads

Not Accepted

Section 4.3.3 of the Austroads Guide to Road Design - Part 6 is not accepted for this section. This is because one assessment process for all embankments is preferred, as presented in Section 4.3.4. Section 4.3.3 of the Austroads Guide to Road Design – Part 6 may be read for guidance but all embankments are to be assessed according to Section 4.3.4 and the decision flow chart in Figure 6-3.

4.3.4 Embankment assessment process

Additions

All embankments are to be assessed in accordance with Section 4.3.6 utilising the decision flow chart in Figure 6-3.
4.3.5 High-consequence hazards

Not accepted

Section 4.3.5 of the *Austroads Guide to Road Design – Part 6* is not accepted for this section because the terminologies and hazard identification outlined could be misinterpreted. Refer below for discussion and guidance on high risk hazards.

Additions

The department does not automatically consider that ‘Schoolyard’, ‘Fuel Storage Facilities’, ‘Transmission Towers’ or similar to be roadside hazards. Correctly, these land uses and structures may contain high consequence vulnerable infrastructure and/or high consequence vulnerable persons. A process for assessing high consequence vulnerable infrastructure and/or high consequence vulnerable persons will be different to the process for assessing roadside hazards.

Refer to Section 4.3.7 for guidance on median assessment.

Refer to Section 4.3.6 for definitions of roadside hazard and high consequence infrastructure and high consequence land.

4.3.6 Generalised hazard assessment process

There is no equivalent Section 4.3.6 in *Austroads Guide to Road Design – Part 6*.

New

The department plans, designs and delivers and manages transport infrastructure in an environment of finite resources. It is a responsibility of the department to distribute and consume these finite resources in an efficient manner and consequently it is not possible to sensibly provide transport infrastructure that has zero risk. In terms of road side design and road safety barrier design, this fact is recognised in *Austroads Guide to Road Design – Part 6* and this document. Existing and potential hazards to errant vehicles are assessed under a risk management process including quantitative risk analysis, cost benefit techniques and qualitative evaluation. The Generalised Hazard Assessment Process outlined in Figure 6-3 identifies that competent road side design needs to consider a large number of factors, and each site requires a site specific risk assessment and engineering judgment.

It is important to note that a road safety barrier is not the first treatment option available for hazards to errant vehicles. Step B3 in the ‘Generalised Hazard Assessment Process’ (Figure 6-3) identifies the treatment order of priority as:

1. Remove the hazard
2. Relocate the hazard
3. Redesign the hazard
4. Reduce the hazard severity
5. Redirect the errant vehicle, and
6. Delineate the hazard.
To improve consistency in site specific risk assessment and engineering judgment, hazards to errant vehicles have been categorised into the following:

1. Roadside Hazard
2. High Consequence Infrastructure
3. High Consequence Land.

The following provides the definitions for the hazard categories above and provides guidelines that may be used to assist engineering judgment in determining a priority towards the distribution of the department’s finite resources.

**Definitions**

**Roadside Hazard (denoted as Category H1):** a roadside hazard is a natural or artificial object or feature that is located between the edge of traffic lane and road corridor boundary, or within a median; that if impacted by an errant vehicle the consequences could include:

- significant personal injury (including fatal injury) to the occupants of the errant vehicle.

Examples include, but are not limited to, tree, utility pole, culvert, embankment or vehicle in opposing lane.

There may be natural hazards located outside the road corridor, for example a steep embankment or cliff, which may need to be considered. Their consideration should take into account local site specific circumstances and local jurisdictional aspects. Their assessment and determination of their priority should follow a process similar to that of roadside hazards.

**High Consequence Infrastructure (denoted as Category H2):** high consequence infrastructure is an artificial object for the purpose of public utility that can be located anywhere but cannot feasibly be removed or relocated; that if impacted by an errant vehicle the consequences could include:

- significant personal injury (including fatal injury) to the occupants of the errant vehicle, and
- may directly cause significant personal injury (including fatal injury) to others in or around the incident site, and
- may indirectly cause a significant disruption to a sector of the public community.

Examples include, but are not limited to, bridges, gantries, rail infrastructure and air transportation on the ground and electricity transmission towers.

**High Consequence Land (denoted as Category H3):** high consequence land is a lot or part of a lot, the primary use of which is not for public utility, that is located outside of the road corridor; that if encroached into by an errant vehicle the consequences could include:

- significant personal injury (including fatal injury) to the occupants of the errant vehicle, and
- may directly cause significant personal injury (including fatal injury) to predictably high concentrations of people in or around the incident site.

Examples may include some school yards, child care centres and fuel storage facilities but generally do not include residential or commercial land uses.
Process

A Generalised Hazard Assessment Process is shown in Figure 6-3. This process relates specifically to projects in Queensland where three different categories of hazard are defined above. In summary:

- Category H1 is **Roadside Hazards**.
- Category H2 is **High Consequence Infrastructure** which can be located anywhere.
- Category H3 is **High Consequence Land** that are located outside the road corridor.

The generalised process identifies RISC as the preferred method to conduct the quantitative assessment. Alternative methods may be used if:

i. appropriate justification can be made

ii. the results of the alternative method are equivalent or better in quantitative accuracy, and

iii. a RISC analysis has been undertaken for comparison.

Refer to AS 5100 for hazard assessment process for road safety barriers on bridges.
Figure 6-3 - Generalised hazard assessment process

**Step D1:** Determine Clear Zone & Area of Interest.

**Step D2:** Identify the Hazards.

- H1: Roadside Hazard
- H2: High Consequence Infrastructure
- H3: High Consequence Land Use

**Step D3:** Identify appropriate treatment options to reduce risk.

1. Remove the Hazard
2. Relocate the Hazard
3. Redesign the Roadside
4. Reduce the Hazard Severity
5. Redirect the eminent vehicle (e.g. safety barrier)
6. Delineate the Hazard (e.g. delineate)

**Step D4:** Evaluate treatment options using quantitative and qualitative assessment.

- Quantitative Assessment
- Qualitative Assessment

Use Road Impact Severity Calculation (RISC) to quantitatively evaluate all identified treatments.

Assess treatments with highest BCR against engineering and environmental considerations.

**Step D5:** Rank treatment options and recommend preferred action.

- Prioritise against competing projects according to quantitative and qualitative criteria.

**Step D6:** Design the roadside treatments.

Prepare design documentation in accordance with current standards.
4.3.7 Median assessment process

There is no equivalent Section 4.3.7 in Austroads Guide to Road Design – Part 6.

New

The hazards presented within medians are cross-over crashes and rigid objects in the median. In these aspects, hazards encountered in medians are special cases of the rigid object general case. Refer to Figure 6-4 for guidance on the assessment of warrants for median barriers.

New or Upgraded Motorways >=100km/h

The department will install median barriers on new and upgraded motorways with speed limits greater than or equal to 100 km/h, to reduce the incidence of cross-median head-on crashes, where the two-way annual average daily traffic (AADT) using the facility will be greater than 30,000 vehicles per day within 10 years.

Where the AADT will be less than 30,000 vehicles per day within 10 years, a risk assessment will be carried out to assess the need for a median barrier. The assessment will include consideration of traffic volume, median width and prior crash history.

This applies to all state-controlled roads (including federally funded and franchised).

New or Existing Roads >=80km/h

Once the volume/width combination indicates that an investigation is required, the following factors should be considered:

- Is the median slope non-recoverable or non-traversable?
- Is the profile of the median such that an errant vehicle is likely to be directed across the median?
- Is the median landscaped such as to reduce the speed and/or chance of an errant vehicle crossing the median?
- Is there a high percentage of heavy vehicles?

If further investigation is desired to determine sensitivity of design parameters, then the RISC software may be used.

The investigation of warrants for median barrier is usually only recommended in high speed environments. However, in low speed environments median barrier might be appropriate:

- where the roadways on either side of the median are graded independently resulting in a significant height difference and a steep slope across the median, and/or
- for treating sites with pre-existing adverse crash history where median barrier may reduce the severity, if not the frequency, of incidents.

If the median is wide enough and flat enough to accommodate the deflections of flexible or semi-rigid safety barriers, the use of these safety barriers may be appropriate. For narrow medians where RISC indicates a high enough Benefit Cost Ratio (BCR) to warrant a safety barrier, for instance on high volume roads, a rigid safety barrier is recommended since rigid safety barrier systems have negligible deflection on impact and low repair costs.
Figure 6-4 - Median barrier warrants assessment guideline

**TMR Policy**

**Speed >= 100km/hr (New and Upgraded Motorways Only)**

**Guideline**

**Speed >= 80km/hr (New and Existing Divided Roads)**

*New or Existing Roads < 80km/h*

Assess risks based on site specific circumstances.

4.5.4 Methods for quantitative analysis

**Additions**

The preferred method of quantitative assessment of risk is RISC (refer Section 4.5.7 and Appendix G). Alternative methods may be used if appropriate justification can be made including that the results of the alternative method are demonstrated to have greater quantitative accuracy and a RISC analysis has been undertaken for comparison.

4.5.5 Simple manual method

**Not Accepted**

Section 4.5.5 of the Austroads Guide to Road Design - Part 6 is not accepted for this section for the reasons provided in Section 4.5.4 above; but may be considered informative.

Refer to Section 4.5.7 for the approved quantitative analysis method.
4.5.6 Detailed manual method

Not Accepted

Section 4.5.6 of the *Austroads Guide to Road Design – Part 6* is not accepted for this section for the reasons provided in Section 4.5.4 above; but may be considered informative.

Refer to Section 4.5.7 for the approved quantitative analysis method.

4.5.7 Roadside impact severity calculator

Additions

Generally, if RISC indicates that the installation of a roadside barrier has the following Benefit Cost Ratios (BCRs), the barrier should not be installed:

- BCR < 1, generally a barrier should not be installed because this value indicates an economic disadvantage to the community.
- BCR < the value currently deemed by the Principal at the Program or Project level to be affordable in the current economic climate.

The principles above are particularly applicable for the shielding of roadside hazards (refer to Section 4.3.6). In some circumstances, however, exceptions to BCR principles above will apply and the barrier may still be warranted. Examples include:

1. The protection of infrastructure that if impacted by an errant vehicle, could cause an extreme event resulting in significant injury to others in or around the incident site or may cause a significant disruption to a sector of the public community. Typical examples include overpasses and if in close proximity to the roadway: bridge piers, gantries, rail infrastructure and electricity transmission towers.

2. The protection of land located outside of the road corridor that if encroached by an errant vehicle may cause an extreme event resulting in significant injury to others e.g. fuel storage facilities in close proximity to the roadway.

Assuming that the above principles on BCR indicate that a roadside barrier is warranted in a particular location, refer to Section 6.3.13 for guidance on the level of barrier containment required.

4.5.8 Roadside safety analysis program

Not Accepted

Section 4.5.8 of the *Austroads Guide to Road Design – Part 6* is not accepted for this section for the reasons provided in Section 4.5.4 above. However, Section 4.5.8 of the *Austroads Guide to Road Design - Part 6* may be used for quantitative analysis when accompanied with appropriate justification and a RISC analysis has been undertaken for comparison.

Refer to Section 4.5.7 for the approved quantitative analysis method.

4.5.9 Alternative crash risk method

Not Accepted

Section 4.5.9 of the *Austroads Guide to Road Design – Part 6* is not accepted for this section for the reasons provided in Section 4.5.4 above; but may be considered informative.

Refer to Section 4.5.7 for the approved quantitative analysis method.
4.5.10 Low volume roads with a consistent roadside environment

There is no equivalent Section 4.5.10 in *Austroads Guide to Road Design – Part 6*.

**New**

Where traffic volumes are low and a consistent road environment is provided (i.e. roadside hazards are at a uniform offset), or speeds are restricted by the road alignment (e.g. mountainous terrain), the guidelines elsewhere in this document may not necessarily apply. The combination of the low number of likely encroachments, the high cost of treatment combined with driver expectations may mean that, for example, the installation of a roadside barrier cannot be justified.

Analysis of crash data from safety audits has indicated that the frequency of crashes tends to increase at the interface between varying types of road environment, or inconsistent segments. An example of this is the first tight curve after a long straight section of roadway.

Based on this experience, it is considered that the following process should be considered in segments with consistently located hazards:

- improve delineation to provide drivers with the best possible indication of the roadway alignment
- provide safety barrier (if justified based on embankment/hazard attributes) at the interface between varying types of road environment, and
- monitor the crash database to identify any particular locations in which roadside barrier may be justified on crash experience.

4.6.1 General

**Differences**

The preferred method of quantitative assessment of risk is RISC (refer Section 4.5.7 and Appendix G). Alternative methods may be used if:

i. appropriate justification can be made, and
ii. the results of the alternative method are equivalent or better in quantitative accuracy, and
iii. a RISC analysis has been undertaken for comparison.

4.6.4 Risk Step R3 – Calculate crash cost for hazard

**Differences**

Table 4.8 of the *Austroads Guide to Road Design – Part 6* is accepted, however note that column ‘Cost $’ is outdated and the department should be contacted for current figures.

4.8 Design Step D6: Design the roadside treatments

**Additions**

Practitioners are reminded that all roadside safety barrier designs must be supervised and certified by a Registered Professional Engineer of Queensland (RPEQ).
5 Treatment options

5.3 Effectiveness of treatment options

Additions

Section 5.3 of the *Austroads Guide to Road Design - Part 6* is accepted because the effectiveness of treatments needs to be established specific to each site. Table 5.1 in *Austroads Guide to Road Design - Part 6* may be considered informative but should not be used to quantify the effectiveness of the option and does not replace the Generalised Hazard Assessment Process in Section 4.3.6.

5.4 Types of treatments

Additions

Overall, there is a tendency in Section 5.4 of the *Austroads Guide to Road Design - Part 6* to imply a road safety barrier as being a preferred treatment. All treatments need to be identified through the Generalised Hazard Assessment Process in Section 4.3.6 above. A road safety barrier is often not the only or preferred treatment option for any particular hazard.

5.4.1 Treatments for trees

Differences

There are more than two options to treat tree hazards (for example “leave as is” or “delineate”). Refer to the ‘Generalised Hazard Assessment Process’ in Section 4.3.6.

5.4.4 Treatments for verges

Differences

A verge is not necessarily a hazard unless it has characteristics which are hazardous. It is noted that no treatments for verges have been identified in this section.

Additions

Provide appropriate surface drainage, particularly to reduce aquaplaning potential.

5.4.5 Treatments for drains

Not Accepted

Section 5.4.5 of the *Austroads Guide to Road Design - Part 6* is not accepted for this section as treatments for drains need to be designed in accordance with the Transport and Main Roads *Road Drainage Manual*; but may be considered informative. Refer to Transport and Main Roads *Road Drainage Manual*.

5.4.6 Treatments for drainage features

Not Accepted

Section 5.4.6 of the *Austroads Guide to Road Design - Part 6* is not accepted for this section as treatments for drains need to be designed in accordance with the Transport and Main Roads *Road Drainage Manual*; but may be considered informative. Refer to Transport and Main Roads *Road Drainage Manual*. 

5.4.13 Treatments for poles

Differences

‘Impact absorbing’ poles are not included in the ‘frangible’ pole category. Impact absorbing poles are a separate category of pole type.

The statement: “Impact absorbing poles should be favoured over slip-base poles where there is closely abutting development, pedestrian and parking activity and a low traffic speed environment” is not accepted. Selection of the pole type will depend on the local site circumstances.

Refer to Transport and Main Roads Design Guide for Roadside Signs and Standard Drawings for overriding policy and design parameters.

Table 5.2, Figure 5.4 and Figure 5.5 may be considered informative only, but not as a prescriptive method.

Additions

Poles - General

Poles of various types are erected in road corridors and beside roads. No unnecessary poles should be erected in the road corridor.

When a pole must be erected in the road corridor, the options or combination of options for treatment should determine which option presents the lowest risk:

1. a pole located as far as possible from the travelled way, preferably beyond the clear zone, or
2. a pole provided with a breakaway or frangible design where appropriate, also located as far from the travelled way as possible
3. locate pole behind any existing road safety barrier
4. treat the pole, for example:
   i. make the pole a breakaway or frangible design where appropriate, or
   ii. provide a road safety barrier if required, or
   iii. any other suitable treatment or combination of treatments if required.

If road safety barrier is required to shield a pole, adequate clearance, commensurate with the barrier type, between the pole and the barrier must be provided. Poles should not be placed in the run-out area required by gating road safety barrier end treatments (e.g. such as the MELT).

Poles should not be erected at locations where they may be more vulnerable such as the following:

- adjacent to horizontal curves with a speed value less than 80% of the 85th percentile speed of the element
- on most traffic islands (particularly small ones) at intersections
- on narrow medians
- adjacent to road pavements that may become slippery under adverse conditions, and
- in gore areas adjacent to off ramps (poles in gore areas should be avoided).
Circumstances where a breakaway design may not be appropriate are:

- in locations where regular parking or other slow speed activity may result in accidental dislodgement of the poles
- in narrow medians where the falling pole would not fall clear of the running lanes, and/or
- in areas where the fall of the pole would foul overhead electricity conductors.

**Poles - Gantries**

Refer to Transport and Main Roads *Design Criteria for Bridges and Other Structures*.

**Poles - Lighting**

Lighting poles are an essential part of the road infrastructure and their location is defined by the technical requirements of the lighting design.

**Poles - Electricity/Utility**

Poles such as overhead electricity poles are placed in the road corridor for the convenience of the electricity utility and their location must be determined by the safety requirements of the road.

**Poles – Located near kerbs**

In urban areas on kerbed roads, poles should be placed as far behind the kerb as possible. If it can be achieved, poles should be located on the property side of the footpath.

**Poles - Traffic signals**

Since traffic signals are usually located at intersections, there is usually no opportunity to shield them from the traffic stream. Nor is it practicable to make the pedestals breakaway or frangible.

Shared pole positions are desirable in reducing the number of poles required to meet the various intersection needs.

**Poles - slip based**

Placing slip base poles on batters often results in the slip base being too high or too low to perform as designed. In addition, providing sufficient room for maintenance vehicles to stop clear of the through traffic lanes can be an issue. To overcome these problems, it may be appropriate to provide a 1 m wide flat area beyond the poles for the full extent of the lighting installation.

### 6 Road safety barriers

#### 6.1.2 General requirements for road safety barrier systems

**Additions**

The department has adopted AS/NZS 3845 (Standards Australia 1999) test standards for crash testing of barriers and end treatments and the major principals behind its public domain systems. The department has accepted some systems which have not been crash tested or rigorously assessed but are deemed to be acceptable by way of continued satisfactory performance in the field, as allowed under AS/NZS 3845. Transport and Main Roads documents its current list of accepted products in *Road Safety Barrier Systems, End Treatments and Other Related Road Safety Devices*.
6.2.1 Site conditions

Differences

The minimum barrier lengths quoted in Table 6.2 of the Austroads Guide to Road Design – Part 6 are not accepted. Transport and Main Roads minimum barrier lengths are provided in the current list of approved products in Road Safety Barrier Systems, End Treatments and Other Related Road Safety Devices.

Additions

Life cycle costs

For the conditions found in the Queensland roadside environment (e.g. the presence of termites) life cycle costs have dictated the choice of steel posts over wooden posts for guardrail installations. Treatment of frangible wooden posts of end treatments also creates an environmental issue when disposal is required after crashes, again dictating the choice of steel posts as shown in Transport and Main Roads Standard Drawings.

Routine maintenance costs

These costs are attributable to those maintenance activities undertaken on a routine basis to ensure the operation of the barrier is not compromised. These activities may include periodic mowing and removal of vegetation around the barrier, and checking of structural attachments, particularly for semi-rigid systems. Vegetation maintenance costs around barriers can be significantly reduced or eliminated by appropriate treatment of the surface around the installation.

As with the selection process defined for longitudinal barriers, the cost and maintenance aspects of an end treatment require detailed consideration.

Collision maintenance costs

Collision maintenance costs will be a function of the frequency of impact. The number of crashes that will occur along a particular installation depends upon a number of factors including traffic speed and volume, roadway alignment and the distance between the edge of the running lane and the barrier itself. Consideration of these factors will aid in assessing the collision maintenance costs of the selected barrier. These costs may be quite high if the end treatment is subject to a high impact frequency or if the cost of replacement parts is high. For installations with a high frequency of crashes with the end treatments, consideration should be given to the use of re-useable end treatments. Alternatively, a complete redesign of the situation might be appropriate in some cases. If nuisance crashes are relatively common, a crash cushion with redirection capability should reduce or eliminate the maintenance effort required for minor repairs or partial replacement of an end treatment system.

The cost and availability of replacement parts will influence the type of system implemented. Spare parts must be available to ensure the system is repaired within the shortest time. If they are not available, a temporary safety barrier should be installed and both spare parts and temporary safety barriers should be a design consideration.

Barriers requiring minimal collision maintenance reduce the risk to maintenance crews, especially on high speed, high volume roads (AASHTO 2011).
6.3.3 Step B2 – Determine the objectives of the safety barrier

**Differences**

The fourth paragraph including dot points in Section 6.3.3 of the *Austroads Guide to Road Design – Part 6* is potentially misleading. To clarify:

- Road safety barrier tests may include a range of vehicles including heavy trucks. The ‘performance’ of a road safety barrier in-situ depends on a much larger range of variables than the ‘performance’ obtained from a crash test.

- Road safety barriers cannot have ‘reduced performance’ if impacted under conditions that have not been crash tested. Rather the performance of a road safety barrier may yield unexpected outcomes if impacted by vehicles and conditions different to those that have been crash tested or verified under in-situ performance data.

6.3.4 Step B3 - Determine the lateral position of the barrier

**Additions**

*Installations in proximity to batters*

Barriers should not be installed on batters with transverse slopes steeper than 1 on 10. If a barrier is to be installed on batters with slopes steeper than 1 on 10 they are to be positioned either between the traffic and the batter or beyond the batter altogether.

In some situations, where the slope is steeper than 1 on 10, flattening of the barrier slope in front of the barrier to 1 on 10 or flatter will be required.

Similar to crashes involving kerbing, a wide range of factors will influence the behaviour and trajectory of errant vehicles as they traverse batters (e.g. suspension stiffness, vehicle weight, speed of impact, angle of impact).

Consequently there is uncertainty about where to position barriers so that:

- the vehicle does not vault over the barrier, or

- the vehicle does not go under the barrier with consequent snagging on the barrier supports and other problems.

This uncertainty makes it difficult to position barriers on batters such that their effective operation is assured. Commentary 12 in *Austroads Guide to Road Design – Part 6* provides some guidance on this issue.

6.3.5 Offset to travel lane

**Additions**

The minimum clearance to the safety barrier should be 0.5 m to allow for vehicle overhang. Clearance may need to be more than 0.5 m; designers should check clearance to the barrier is adequate for the design (or check) vehicle using its swept path.

**Differences**

*Barrier setback from kerb*

Kerbs should not be placed in proximity to barrier systems, particularly in environments with speed limits above 70 km/h.
Shy line offset

The shy line offset distances listed in Table 6.4 of the *Austroads Guide to Road Design – Part 6* are not accepted. To be consistent with current practice, shy line offsets are provided in the Table 6-3 below.

**Table 6-3 - Shy line distances**

<table>
<thead>
<tr>
<th>85th Percentile Speed (km/h)</th>
<th>Shy Line Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nearside (Left)</td>
</tr>
<tr>
<td>≤ 70</td>
<td>1.5</td>
</tr>
<tr>
<td>80</td>
<td>2</td>
</tr>
<tr>
<td>90</td>
<td>2.5</td>
</tr>
<tr>
<td>≥ 100</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Offside (Right)</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

Flaring

The *Austroads Guide to Road Design – Part 6* states that “the flare rates applied should not enable impacts with the road safety barrier to occur at an angle greater than 25 degrees” which is a misleading statement. This statement was included because barriers are typically tested at 25 degrees and may not effectively operate at higher impact angles.

The flare rates listed in Table 6.5 of the *Austroads Guide to Road Design – Part 6* are not accepted because there are minor differences with traditional departmental practice. Flare rates are provided in Table 6-4 below.

**Table 6-4 - Suggested flare rates**

<table>
<thead>
<tr>
<th>Design Speed (km/h)</th>
<th>Flare Rate for Flare Rate for Barrier beyond Shy Line Flare Rate for Barrier inside Shy Line</th>
<th>Flare Rate for Barrier beyond Shy Line</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum flare rate for rigid barrier systems</td>
<td>Suggested maximum flare rate for semi-rigid systems</td>
</tr>
<tr>
<td>110</td>
<td>30:1</td>
<td>20:1</td>
</tr>
<tr>
<td>100</td>
<td>30:1</td>
<td>18:1</td>
</tr>
<tr>
<td>90</td>
<td>25:1</td>
<td>15:1</td>
</tr>
<tr>
<td>80</td>
<td>20:1</td>
<td>15:1</td>
</tr>
<tr>
<td>70</td>
<td>15:1</td>
<td>10:1</td>
</tr>
<tr>
<td>60</td>
<td>15:1</td>
<td>10:1</td>
</tr>
<tr>
<td>50</td>
<td>15:1</td>
<td>10:1</td>
</tr>
</tbody>
</table>

6.3.6 Support width

**Differences**

Guideline support widths for w-beam are identified in Transport and Main Roads Standard Drawing 1474 and are preferred in comparison to any guideline values obtained from Section 6.3.6 in the *Austroads Guide to Road Design – Part 6* or Appendix H in the *Austroads Guide to Road Design – Part 6*. 

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Support widths for proprietary systems (e.g. wire rope safety barrier systems) should be obtained from the supplier of the system and detailed design based on site specific circumstances.

Additions

The designer may need to take into consideration the geotechnical conditions at the site.

6.3.9 Barrier location in medians

Additions

Section 6.3.9 of the Austroads Guide to Road Design – Part 6 is accepted for this section but the warrants for road safety barriers in medians should be assessed in accordance with Section 4.3.7.

6.3.11 Wider medians

Differences

Figure 6.10 of the Austroads Guide to Road Design – Part 6 is generally accepted, however the point of need overlaps between separate barriers should be perpendicularly aligned (e.g. as indicated in Figure C14 1 of the Austroads Guide to Road Design – Part 6).

6.3.13 Step B5 – Determine the barrier containment level required

Additions

Containment level selection

Containment level selection cannot be defined prescriptively; rather it is determined using engineering judgement using information obtained from site specific risk assessments.

In general, the default containment level for roadside barriers is TL3. This is based on historical practice within Queensland and Australia. If a TL4 barrier is just as cost effective as a TL3, the TL4 should be used if it meets all of the design requirements e.g. deflection.

Barriers with a higher containment level than TL4 would typically be considered in the following circumstances:

- where the number of errant heavy vehicles is high or likely to be high, and
- where the severity and/or consequence of impacting the hazard/s is high.

Examples of the above are as follows:

- There is a combination of minima occurring that would cause a high likelihood of heavy vehicles becoming errant e.g. a ‘tight’ horizontal curve on a long steep downgrade on a high steep batter on a freight route.
- Where there is infrastructure or land that if impacted by an errant heavy vehicle, could cause an extreme event.
- There is a crash history involving heavy vehicles.
- In narrow medians of high-speed, high-volume roads (especially motorways) carrying high percentages of heavy vehicles.

If a barrier with a higher containment level than a TL4 is being considered, TL5 is the normal choice. Containment levels higher than a TL5 would typically only be considered in rare situations for high consequence infrastructure or high consequence land (refer Section 4.3.6).
For all road projects, a detailed report on the roadside design including the risk assessment is the minimum level of documentation that is expected to be produced justifying the use of, or omission of, roadside barriers.

### 6.3.14 Step B6 – Choose the barrier type

**Differences**

The guidance in Figure 6.17 of the *Austroads Guide to Road Design – Part 6* about the preferred installation practice for rigid barriers is not accepted and instead, the following guidance should be adopted:

- For roads with a superelevation less than 5 per cent it is generally accepted that barriers will be vertical unless they are temporary barriers and are positioned on the pavement.
- For roads with a superelevation more than 5 per cent it is generally accepted barriers on the low side of a superelevated road should be vertical and on the high side they should be normal to the pavement, or unless specified otherwise.

**Additions**

Overlays (or lift or corrector) courses placed after initial construction of the barrier may reduce the relative/residual height of barriers and/or their profile. Designers should make provision for such future treatments when choosing a barrier.

Where possible, continuity of a barrier type should be maintained along a road section. New installations should be compatible with existing lengths of barrier and capable of having suitable transition devices to connect them to existing installations. The type of barrier installed must also be compatible with the selected end treatments.

**Rigid barriers**

Transport and Main Roads rigid barrier systems are illustrated in *Standards Drawing Roads*. Single slope barriers are recommended for all new designs with the exception of short lengths of barrier, which join with existing ‘F’ type barrier.

‘F’ type barrier is not recommended except where it is necessary to join a short length of new rigid barrier to an existing ‘F’ type barrier. ‘F’ type barrier is not recommended because small, front wheel drive vehicles have a tendency to “barrel roll” when hitting ‘F’ type barriers, particularly at speeds approaching 80 km/h. Research papers and in-service experience have validated this potential outcome.

Specific to rigid median barrier installations, the type of barrier used should be compatible with other median features, such as luminaire supports, sign supports and bridge piers.

When using rigid barrier, designers must check sight distances, especially sight distances around horizontal curves, at intersections and at accesses, to be checked for adequacy.

Drainage should be checked and drains installed from the high side of superelevated sections to prevent ponding.

**Height of rigid concrete barrier**

Rigid concrete barriers can be different heights. The default permanent concrete barrier has a containment level rated at TL-5.
A 1100 mm high single slope concrete barrier has the following characteristics:

- It is rated at TL-5 when appropriately fixed to ground (pinned or embedded to pavement) and can accommodate one 35 mm thick pavement overlay.
- After several pavement overlays (i.e. more than 35 mm increase in height since original installation) the barrier can no longer be considered to be a full TL-5 containment level system but it could be expected to have a containment level greater than TL-4.

Selection of a rigid single slope concrete barrier height different to 1100 mm high may be determined necessary for a site due to any of the following reasons:

1. Sight distance requirements
2. TL-5 containment is not required as demonstrated by site specific risk assessment. For example, low design speed, or where there is low exposure to the risk of heavy vehicle impacts.

Luminaire supports on new works cannot be located on top or within rigid concrete barriers lower than 1100 mm high.

Presently, concrete barrier heights different to 1100 mm high are subject to the ‘Design Exception’ process and documentation.

Table 6-5 outlines standardised heights for permanent single slope concrete barrier.

<table>
<thead>
<tr>
<th>Single Slope Rigid Concrete Barrier Height</th>
<th>Containment Level</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>820 mm</td>
<td>TL-3</td>
<td>Containment level will be reduced if pavement height increases.</td>
</tr>
<tr>
<td>920 mm</td>
<td>TL-4</td>
<td>Containment level will be reduced if pavement height increases.</td>
</tr>
<tr>
<td>1100 mm</td>
<td>TL5</td>
<td>Allows for future increase in pavement of 35 mm. Containment level will be reduced if pavement height increases more than 35 mm.</td>
</tr>
</tbody>
</table>

**Semi-rigid barriers**

The deflection of semi-rigid barriers is less than that of flexible systems, but more than rigid systems. The barrier redirects colliding vehicles by some of the collision forces being transferred to the support posts of the barrier, which either break away or bend on impact, and to tension in the barrier rails, which redirect the vehicle. Because these systems have stiffer rails than flexible systems, resistance is achieved through the combined flexure and tensile strength of the rail. The undamaged adjacent posts provide support. The tension in the rails is dependent on the correct installation of the end anchorages so attention needs to be directed to this aspect when installing these systems. An increase in the number of posts will reduce the deflection on impact. Increasing the number of posts will strengthen and stiffen the barrier to reduce deflection for the situation when an isolated hazard is near a semi-rigid barrier.
Flexible barriers

Flexible barrier systems, particularly the wire rope types, may require immediate repair following an impact, since the system may not function appropriately for any subsequent impacts.

Bridge barriers

AS 5100 should be consulted for all barriers on bridges. All bridge barriers require appropriate transition or interface with any road safety barriers on the approaches.

Pre-existing bridge barriers which are not designed to meet AS 5100 require specialist advice on the ability to either:

- upgrade the longitudinal barrier, or
- implement standard transitions to roadside barriers.

Any upgrading or retrofitting of existing bridge railing requires specialist advice with regard to the following issues:

- strength of the railing required
- longitudinal continuity of the system
- effects of kerbs or walkways, and
- snagging potential.

A decision to remove, replace, upgrade or retrofit existing bridge barrier should be based on a risk based analysis approach, using appropriate benefit/cost calculations such as the RISC program.

6.3.15 Step B7 – Determine dynamic deflection

Additions

Dynamic deflections are to be determined in the following order:

- In concept/feasibility design, using indicative deflections in Table 6.7 of the Austroads Guide to Road Design – Part 6.
- In detailed design in the normal design domain, using product specific information for both proprietary and non-proprietary systems. Designers should contact suppliers of proprietary systems for guidance on deflections.
- In detailed design in the extended design domain or as a design exception, designers need to make informed design decisions regarding a systems deflection based on site specific circumstances and a site specific risk assessment.

6.3.16 Step B8 – Determine vehicle roll allowance and system width

Not Accepted

Section 6.3.16 of the Austroads Guide to Road Design – Part 6 is not accepted for this section because the quantitative information is incorrect. Specifically, the vehicle roll allowance and Figure 6.20 and Table 6.8 are not accepted. As the concepts of vehicle roll allowance and the definition of ‘system width’ is not accepted, there is no appropriate replacement content for this section.
6.3.17 Step B9 – Determine the working width

**Differences**

Working width is to be estimated using Table 6-6 as a guide.

**Table 6-6 - Working widths**

<table>
<thead>
<tr>
<th>Speed Zone</th>
<th>0%</th>
<th>3%</th>
<th>7%</th>
</tr>
</thead>
<tbody>
<tr>
<td>High – 100 km/hr</td>
<td>0.8 m</td>
<td>0.9 m</td>
<td>1.1 m</td>
</tr>
<tr>
<td>Low – 60 km/hr</td>
<td>0.5 m</td>
<td>0.6 m</td>
<td>0.8 m</td>
</tr>
</tbody>
</table>

6.3.19 Step B11 – Determine barrier points of need

**Differences**

The “Angle of Departure” method is not accepted because:

1. the department has consistently used the ‘run out length’ method, and
2. it is preferable to have a single consistent design methodology rather than a multitude of design methods.

Table 6.10 and Figures 6.21, 6.22, 6.26, 6.27 and 6.28 are not accepted and are not to be used.

The department only accepts ‘Run Out Length’ method for determining barrier points of need.

**Additions**

Designers are recommended not to refer to ‘Points of Need’ terminology. Rather the primary two terms necessary to adequately describe the geometrical layout of a road safety barrier design are the ‘Length of Need’ and ‘Point of Redirection’, explained as follows:

- ‘Length of Need’ is the length of barrier designed to achieve specified objectives.
- ‘Point of Redirection’ is a road safety barrier product specific variable and may be different between different products. A road safety barrier must align the selected system’s leading and/or trailing ‘Point of Redirection’ with the extremities of the ‘Length of Need’.

Figure 6-5, Figure 6-6 and Figure 6-7 indicate equations and set-out methods for determining the location of the road safety barrier based on the ‘Length of Need’.
Figure 6-5 - Equations and set-out method for Length of Need – Part 1 of 3

Hazard on a Straight Road

Length of Need = Distance between $P_L$ and $P_T$.

- $P_L$ = Leading Point of Need
- $P_T$ = Trailing Point of Need
- $L_{L,L}$ = Length of leading terminal
- $L_{T,T}$ = Length of trailing terminal
- $L_B$ = Run-Out Length
- $L_D$ = Distance edge line to front face of barrier
- $L_C1$ = Clear Zone for Lane 1
- $L_C2$ = Clear Zone for Lane 2
- $L_{HR}$ = Distance Edge line to Rear of Hazard
- $L_{HF}$ = Distance Edge line to Front of Hazard
- $L_{1,L}$ = Leading distance between hazard and beginning of flare
- $L_{2,T}$ = Trailing distance between hazard and beginning of flare

Equations:

$$X_{1,\text{Parallel}} = \frac{L_{ax} - L_{b}}{L_{ax}}$$

$$X_{1,\text{Flare}} = \frac{L_{ax} + (b/a)L_{ax} - L_{b}}{(b/a) + L_{ax}/L_{a}}$$

$$X_{2,\text{Parallel}} = \frac{(L_{ax} + L_{b}) - (L_{ax} + L_{b})}{(L_{ax} + L_{b})}$$

$$X_{2,\text{Flare}} = \frac{(L_{ax} + L_{b}) - (b/a)L_{ax} - (L_{ax} + L_{b})}{(b/a) + L_{ax}/L_{a}}$$

$$Y_L = L_{ax} - (L_{ax}/L_{a})X_1$$

$$Y_T = (L_{ax} + L_{b}) - (L_{ax} + L_{b})X_2$$

Diagram:

(a) One Way

(b) Two Way
Figure 6-6 - Equations and set-out method for Length of Need – Part 2 of 3

Road Safety Barrier Length of Need Analysis

Hazard on Outside of a Horizontal Curve

Length of Need = Distance between $P_L$ and $P_T$.

**O1**
Road: One way, Hazard: Outside of a Curve, $D_{hazard} > L_R$
Method:
Leading Point of Need
(1) Find the leading most edge of the hazard, $H_L$, and draw a perpendicular line between this point and the carriageway edge line.
(2) Scribe an arc with radius equal to $L_R$ and find where the arc intersects the carriageway edge line, $P_{EL}$.
(3) Draw a straight line between $P_{EL}$ and $H_L$. Leading Point of Need, $P_L$, must intersect with this line.

**O2**
Road: Two way, Hazard: Outside of a Curve, $D_{hazard} > L_R$
Method:
Leading Point of Need
(1) Same as O1.

**O3**
Road: One way, Hazard: Outside of a Curve, $D_{hazard} \leq L_R$
Method:
Leading Point of Need
See Method O4

**O4**
Road: Two way, Hazard: Outside of a Curve, $D_{hazard} \leq L_R$
Method:
Leading Point of Need
(1) Find the leading most edge of the hazard, $H_L$, and draw a line between this point and the tangent to the Lane 1 edge line.
(2) Draw a straight line between $P_{EL}$ and $H_L$. Leading Point of Need, $P_L$, must intersect with this line.

**Trailing Point of Need**
(1) Find the trailing most edge of the hazard, $H_T$, and draw a line between this point and the tangent to the Lane 2 edge line.
(2) Draw a straight line between $P_{EZ}$ and $H_T$. Trailing Point of Need, $P_T$, must intersect with this line.
**Figure 6-7 - Equations and set-out method for Length of Need – Part 3 of 3**

**Road Safety Barrier Length of Need Analysis**

**Hazard on Inside of a Horizontal Curve**

Length of Need = Distance between $P_L$ and $P_T$.

$$D = \sqrt{R^2 - \left(R - 0.5 L_{HR}\right)^2}$$

**1. Road: One way, Hazard: Inside of a Curve, $L_R < D$**

Method:

**Leading Point of Need**

(1) Find the leading most edge of the hazard, $H_L$ and draw a perpendicular line between this point and the carriageway edge line.

(2) Scribe an arc with radius equal to $L_R$ and find where the arc intersects the carriageway edge line, $P_{L1}$.

(3) Draw a straight line between $P_{L1}$ and $H_L$. Leading Point of Need, $P_L$, must intersect with this line.

**Trailing Point of Need**

(1) Find the trailing most edge of the hazard, $H_T$ and draw a perpendicular line between this point and the carriageway edge line. Trailing Point of Need, $P_T$, must intersect with this line.

**2. Road: Two way, Hazard: Inside of a Curve, $L_R < D$**

Method:

**Leading Point of Need**

(1) Same as 1.

**Trailing Point of Need**

(1) Find the trailing most edge of the hazard, $H_T$ and draw a perpendicular line between this point and the Lane 2 edge line.

(2) Scribe an arc with radius equal to $L_{R1}$ and find where the arc intersects the Lane 2 edge line, $P_{L2}$.

(3) Draw a straight line between $P_{L2}$ and $H_T$. Trailing Point of Need, $P_T$, must intersect with this line.

**3. Road: Two way, Hazard: Inside of a Curve, $L_R = D$**

Method:

**Leading Point of Need**

See Method 14

**Trailing Point of Need**

See Method 11

**4. Road: Two way, Hazard: Inside of a Curve, $L_R > D$**

Method:

**Leading Point of Need**

(1) Find the leading most edge of the hazard, $H_L$ and scribe an arc with radius equal to $L_R$ and find where the arc intersects the carriageway edge line, $P_{L1}$.

(2) Draw a straight line between $P_{L1}$ and $H_L$. Leading Point of Need, $P_L$, must intersect with this line.

**Trailing Point of Need**

(1) Find the trailing most edge of the hazard, $H_T$ and scribe an arc with radius equal to $L_R$ and find where the arc intersects the Lane 2 edge line, $P_{E1}$.

(2) Draw a straight line between $P_{E1}$ and $H_T$. Trailing Point of Need, $P_T$, must intersect with this line.
6.3.22 Step B14 – Choose terminal treatments

**Differences**

To clarify, a crashworthy end treatment should be provided to all longitudinal barriers regardless of the terminus being in the clear zone or not. Not using a crashworthy terminal can only be considered after a detailed site specific risk assessment.

6.3.23 Step B15 – Design the transitions between barriers

**Differences**

The design practice, “In the latter case the more flexible system must be placed in front of the more rigid section” is not accepted by the department. A designer needs to consider the direction of the traffic and refer to Figure K2 in Appendix K.

**Additions**

The following criteria are important (AASHTO 2011) when designing a transition section:

- The connection point of the two systems must be as strong as the approach barrier to ensure the connection will not fail on impact by pulling out. (The use of a cast in place anchor or through-bolt connection is recommended).
- It must be designed to minimise the likelihood of snagging an errant vehicle, especially one from the opposing lane on a two-way facility.
- The length of the transition should be long enough to minimise any significant changes in deflection.
- The change in stiffness from the less rigid barrier to the more rigid barrier, over the transition length, should increase with a high degree of continuity. This may be achieved by reducing the post spacing, increasing the post size, strengthening the rail element or a combination of two or all of these techniques.
- Kerb and slope features should be treated.

6.4 General access through road safety barriers

**Additions**

The prevailing site conditions (such as turnouts from driveways) may require the barrier to be installed in segments thereby creating short gaps between adjacent lengths. This practice is not recommended.

If the designer, using sound engineering judgement, chooses to use a configuration where gaps exist between adjacent lengths then:

- the number of such discontinuities is to be minimised so that the number of ends is reduced to as few as possible
- both the upstream and downstream rail end along each turnout should be equipped with an appropriate end treatment and should be flared where appropriate, and
- barriers should be located so drivers’ visibility is not restricted, especially in the vicinity of intersections.
6.5.1 Motorcyclists

Additions

All roadside elements have potential to be a hazard and the consequences of impact are dependent on the level of occupant protection provided by the occupant’s vehicle.

Field experience with flexible wire rope barriers, as documented in Austroads Guide to Traffic Engineering Practice – Part 15, has shown that the majority of injuries to motorcyclists (or pillions) occur from contact with the support posts and not from the ropes.

In a paper published in the journal of the Australasian College of Road Safety (vol. 20, no. 4 Nov 2009), Grzebieta et al report that "Many myths still pervade concerning how injuries occur when a motorcycle strikes a roadside barrier.... Physics dictates that a rider/pillion passenger travelling at speeds at around 60 km/h or more impacting a crash barrier is at a very high risk of a fatal injury, regardless of whether the barrier is concrete, steel or wire rope". The Grzebieta paper also refers to a report from the Australian Transport Safety Bureau (ATSB) in 2000 entitled Motorcycle and Safety Barrier Crash-Testing: Feasibility Study which includes "No scientifically-based information exists on the comparative performance for motorcyclists of the main barriers types in use, namely concrete, steel W-beam and wire rope". Likewise, this was a conclusion of the EuroRAP Motorcycle Safety Review Panel in their Barriers to change: designing safe roads for motorcyclists report published in 2008, which states "...despite the amount of high profile coverage that wire rope barriers have attracted, limited research does not warrant the inference that they are more or less dangerous than other types of barrier on the market".

The common message which the department accepts is that wire rope barrier systems are not shown to be more dangerous to motorcyclists than other road safety barrier systems.

The advice given in Austroads Guide to Road Design – Part 6 is for information.

6.5.2 Pedestrians and cyclists

Additions

Attachments or modifications to barrier systems are to be avoided wherever possible. Any attachment or modifications to barriers systems should undergo a risk assessment and review in accordance with AS/NZS 3845 prior to approval for use at any particular site. All sites should undergo a site specific risk assessment, which means that a solution developed for one site may not be appropriate for another site.

6.6 Aesthetic road safety barriers

Additions

Section 6.6 of the Austroads Guide to Road Design – Part 6 is accepted for this section but it should be noted that any attachment or modification to an accepted road safety barrier system for aesthetic purposes should undergo a risk assessment and review in accordance with AS/NZS 3845 prior to approval for use at any particular site.
6.8 **Temporary road safety barriers**

There is no equivalent Section 6.8 in *Austroads Guide to Road Design – Part 6*.

*New*

6.8.1 Introduction - Purpose of road safety barriers at road work sites

This section should be read in conjunction with:

- AS/NZS 3845:1999 “Road Safety Barrier Systems” defines a temporary road safety barrier system as “a system designed to be erected and dismantled quickly, used to prevent vehicular access into construction or maintenance work zones. Its purpose is to redirect an impacting vehicle so as to minimize damage to the vehicle and injury to the occupants, while providing worker protection”.

In the context of a work site a safety barrier is a physical barrier separating the work area and the travelled way, designed, as far as practicable, to resist penetration by an out of control vehicle and redirect it back onto the road. Temporary road safety barriers may be used for the following reasons:

- to provide physical protection for workers from errant vehicles entering the worksite
- to protect critical construction works (e.g. such as bridge falsework) from vehicle impact
- to protect traffic from entering work areas where hazards such as trenches and material stockpiles could endanger road users
- to separate opposing traffic where temporary traffic diversions have the potential to cause vehicle conflict
- to minimise road user delays by reducing the need for roadwork site speed limits
- to enhance site safety and job productivity (e.g., by increasing the operational hours of a work site), and/or
- to reduce road user delays where it is considered that traffic volumes, traffic speeds, the nature of the work, worksite/traffic separation and duration of the works, indicate that it is both desirable and practicable to provide such additional protection.

6.8.2 General requirements

Design of work sites shall:

- meet the requirements of the *Work Health and Safety Act (2011)* (and/or any other current relevant legislation)
- be in accordance with the provisions of the Transport and Main Roads *Manual of Uniform Traffic Control Devices* (MUTCD) and specifically Part 3: *Works on Roads* thereof
- be consistent with the requirements of other parts of this manual
- be cognisant of the requirements of the department’s technical specification MRTS02 *Provision for Traffic.*
6.8.3 Purpose of safety barriers at roadwork sites

In determining whether and what temporary road safety barriers should be used, the following factors should be taken into account:

- Can the speed of vehicles be maintained at such a value through the work site that in combination with worker/roadside hazard clearance and the quality of the traffic arrangements (traffic control, road surface/alignment), the risk of injury to either workers or road users is consistent with good practice and the requirements of the Workplace, Health and Safety Act?
- Bearing in mind the duration of the particular works and the space available to locate safety barriers, is it practical to install safety barriers?
- Is the consequential effect of a vehicle striking construction features (e.g. bridge falsework) such that positive protection must be provided?
- In view of the nature and duration of the particular work, the speed of vehicles through the site and the clearance between such traffic and workers/roadside hazards, would the use of safety barriers improve the safety of both workers and road users and should they therefore be provided?

Systems that redirect rather than arrest and contain (capture) generally provide a better solution. However, in some instances, a road safety barrier may be required in order to arrest and contain (capture) a vehicle before it enters a work site. For example, if a side road is used to direct traffic around a construction zone and if an errant vehicle were to continue straight on instead using the side road, then a barrier might be installed directly across the road before the work site.

6.8.4 Operational requirements for the use of barriers at roadwork sites

When barriers are used at roadwork sites the following issues should be managed appropriately.

Installation

Most temporary road safety barrier systems are proprietary systems. Systems accepted for use on state-controlled roads in Queensland are listed in Transport and Main Roads Road Safety Barrier Systems, End Treatments and Other Related Road Safety Devices.

Subject to any conditions of acceptance for use imposed by this department any temporary barrier systems shall be installed or deployed in accordance with the requirements specified by the supplier/manufacturer of the system. Departure from these requirements requires a site specific risk assessment.

Safety barrier foundation

Temporary barrier systems are typically either gravity systems or pinned/anchored systems:

- Gravity systems rely on their own weight to resist deflection.
- Pinned/anchored systems may be anchored at the ends (e.g. either by pinning or anchoring of the system itself or by tethering to an anchored crash cushion) or may be pinned/anchored at intermediate stations along the system.

Designers prescribing the use of pinned/anchored systems need to ensure that the foundation requirements for the system will be met. This is particularly the case when barriers are adjacent to trenches, foundation excavations, etc. Designers shall also ensure that a method of backfilling pin/anchor holes that is acceptable to the party responsible for the pavement is available.
Minimum length

The minimum length of all temporary road safety barriers (excluding terminals) is to be determined from product information (or from the relevant standard drawing where the system is public domain).

However, the actual length of temporary barrier required is to be determined from the length of need for the particular site plus the additional lengths necessary to provide for end treatments.

Designers of temporary work sites should be aware that gravity systems especially require a development length upstream and downstream of the length where they are effective barrier. This development length is less likely to perform as a redirective barrier and as such should be installed ideally (subject to site specific constraints) beyond the clear zone.

All barrier systems are required to be installed with suitable crashworthy end treatments. See section “End treatments for temporary barrier systems” below.

Connection of individual barrier units
(e.g. precast concrete, portable steel barrier and water filled plastic systems).

Installations of unconnected individual units do not form a safety barrier in any way. If impacted, individual units will permit penetration into the “shielded” area and may become a projectile hazard to road workers and/or road users.

For barrier units to act as a safety barrier they must be properly connected to adjacent units for the whole installation to provide barrier continuity. This resists displacement, and ensures that differential movement at the joints between units does not occur.

Except where specifically designed to be connected, barriers comprising different profiles and materials are not to be used in the same installation as ‘pocketing’ could occur due to the differences in stiffness and/or shape.

End treatments for temporary barrier systems

The ends of safety barriers must be appropriately treated, as they can be a major hazard to road users if they are struck end on. End treatments accepted for use on state-controlled roads in Queensland are listed in Transport and Main Roads Road Safety Barrier Systems, End Treatments and Other Related Road Safety Devices.

The most appropriate crashworthy end treatment for a barrier should be selected following consideration of:

- crash cushion characteristics
- re-directive characteristics
- design speed of the road
- space available for installation of the terminal
- capacity to absorb nuisance crashes
- compatibility with barrier type, and
- cost and maintenance factors.

“Flaring to beyond the clear zone” and sloped end terminals are not acceptable solutions for use on state-controlled roads in Queensland.
6.8.5 Barrier lateral location

Offset between barrier and work area/hazard

This offset needs to consider the area and objects in it requiring protection and the permanent and dynamic deflection/working width of the temporary road safety barrier system being considered for use.

Systems that are designed to deflect in order to operate effectively should not be prevented from deflecting by any feature such as kerbs, other safety barriers or retaining walls etc.

Offset between barrier and traffic

Road safety barriers placed parallel to the pavement should not be located more than 5 m from the edge of the travelled lane to reduce the potential angle of impact. However the minimum clearance should not be less than 500 mm.

For driver comfort, and to maintain traffic flow conditions, when temporary road safety barriers are installed on both sides of traffic, it is desirable that the beginnings of the barriers be staggered a minimum of 30 m.

Designers should also be cognisant of the guidance given in this manual for flare and shy line.

Delineation

To provide acceptable night time visibility appropriate retro-reflective delineation devices should be mounted along the safety barrier, generally perpendicular to the direction of traffic.

Drainage

Drainage of the uphill side of barriers needs to be provided to avoid ponding against and/or concentrating flows at the ends of the barrier, both of which can create a hazard to road users (e.g. aquaplaning).

Operational monitoring

Monitoring the performance of barriers in the field is the best way to determine the performance of a barrier in particular situations. These observations will identify any problems that may occur with the system, ensuring optimal performance for future installations. AS/NZS 3845:1999 requires that post-crash evaluations be carried out. After crashes into barrier systems, the following considerations, as a minimum, should be addressed:

- Did the system function as designed?
- Should the system be restored to the condition it was pre-crash?
- If not, which upgrade measures should be carried out to improve the safety of the hazard?

AS/NZS 3845 suggests that part of an action plan for maintenance of safety barrier systems should include the above assessment criteria.
6.9 Road safety barrier retrofit

There is no equivalent Section 6.9 in Austroads Guide to Road Design – Part 6.

New

Road safety barriers and end treatment technology evolves with the desire to improve safety. In some instances, hardware that was once acceptable is no longer acceptable. In the instance where superseded hardware is installed, the department through its Regions should:

1. audit road safety barrier and end treatment inventory, then
2. prioritise the replacement of superseded road safety barriers and end treatments, then
3. progressively implement the replacement of superseded road safety barriers and end treatments when funding and resources are available.

7 Design for steep downgrades

7.5 Key design considerations

Differences

Piles of sand or gravel are not acceptable as ‘last chance’ devices.
References

Transport and Main Roads publication references refer to the latest published document on the departmental website (www.tmr.qld.gov.au).

Transport and Main Roads Design Criteria for Bridges and Other Structures, Brisbane, QLD
Transport and Main Roads Design Guide for Roadside Signs, Brisbane, QLD
Transport and Main Roads Guidelines for Road Design on Brownfield Sites, Brisbane, QLD
Transport and Main Roads Manual of Uniform Traffic Control Devices, Brisbane, QLD
Transport and Main Roads Road Drainage Manual, Brisbane, QLD
Transport and Main Roads Road Safety Barriers Systems, End Treatments and Other Related Road Safety Barrier Devices, Brisbane, QLD
Transport and Main Roads Standard Drawings Roads, Brisbane, QLD
Transport and Main Roads Transport Noise Management Code of Practice, Brisbane, QLD
Appendix A - Terminology

A.1 General terms

A.1.1 Key words

*Not Accepted*

Section A.1.1 of the *Austroads Guide to Road Design – Part 6* is not accepted for this section. Refer to Section A.1.2.

A.1.2 Other general engineering and road safety terms

*Differences*

In instances of conflict, definitions in the *Road Planning and Design Manual* take precedence over definitions in the *Guide to Road Design*.

A.3 Vehicle movement terminology

*Differences*

In instances of conflict, definitions in the *Road Planning and Design Manual* take precedence over definitions in the *Guide to Road Design*.

A.4 Road safety barrier terminology

*Differences*

In instances of conflict, definitions in the *Road Planning and Design Manual* take precedence over definitions in the *Guide to Road Design*.

Alternative definitions for various terms may be found in other documents, for example, AS/NZS 3845, Transport and Main Roads *Road Planning Design Manual* (this document and its other volumes), MASH or NCHRP Report 350.

Figure A 5 and Figure A 6 are not accepted as they include the “angle of departure” method for determining “point of need” which is not an approved method. The figures may be used for information purposes only.
Appendix B – Hazard mitigation worksheet

Not Accepted

Appendix B of the Austroads Guide to Road Design – Part 6 is not accepted for this section and there is no supplement. Refer to Section 4.3.6 – Generalised Hazard Assessment Process.
Appendix C - RTA method

Not Accepted

Appendix C of the Austroads Guide to Road Design – Part 6 is not accepted for this section. Refer to Section 4.3.6 – Generalised Hazard Assessment Process and Appendix G.
Appendix D – Examples of clear zone calculations

D.4 Example 4

Differences

Desirably, the solution to example D4 should not include a barrier outside the shoulder on a 1V:6H batter, rather where possible the lead up to a road safety barrier should be 1V:10H or flatter. Refer to the Transport and Main Roads Guide to Road Design in Brownfield Sites.
Appendix F – Example of manual calculation of run-off road crash numbers and costs

Not Accepted

Appendix F of the Austroads Guide to Road Design – Part 6 is not accepted for this section. Refer to Section 4.3.6 – Generalised Hazard Assessment Process and Appendix G.
Appendix G - RISC method and process

G.1.5 Calculate encroachment frequency

Additions

The base encroachment rate (BER) is 0.00030 enc/km/vear/vpd.

G.1.6 Calculate object collision frequency

Differences

In Section G.1.6 of the Austroads Guide to Road Design - Part 6, RISC equation for CFUC is incorrect where the limit to the sum is based on swath width, SW. Correct equation follows:

\[
CFUC = EF \times \frac{1}{\sin \phi} \times \frac{\sum_{i=1}^{SW} LEP \left( A + |i| \times \cos \phi \right)}{1000}
\]

Where:

- \( \phi \) = Encroachment angle (degrees).

Figure G 5 of the Austroads Guide to Road Design – Part 6 defines when a vehicle is likely to impact a hazard given that it leaves the road at an angle \( \phi \). The reference point on the vehicle is its left rear corner.

Rigid Object Adjusted Offset

For rigid objects the clear zone should be adjusted when positioned on non-recoverable embankment slopes. The actual offset to the rigid object is adjusted to reflect a new effective offset, taking into account the combined effect of both the embankment and the rigid object hazard. Equation 1 is used to calculate the adjusted offset for the object and the following two examples illustrate its application:

Equation 1 - Adjusted offset

\[
\text{Adjusted Offset} = (E_s \times \text{Offset}) + (\text{distance from edgeline to hinge point})
\]

Where:

- \( E_s \) is the adjustment offset factor for slope \( E_s = 1 + \frac{s}{f} \)

- \( s \) is the slope (negative for fill slope), expressed as a ratio, and

- \( f \) is the braking and cornering coefficient of friction (0.4)

Equation 1 should only be used for slopes between 1 on 4 and 1 on 2.5.

For slopes flatter than 1 on 4, \( E_s \) should be taken as 1. For slopes steeper than 1 on 2.5, the adjusted offset distance should be taken as the distance from the edge of the trafficked way to the embankment hinge point.

The adjusted offset is calculated when the actual offset is multiplied by the adjustment factor. This results in the new adjusted offset, which is taken from the hinge point of the slope.
Example 1

If the cross section of the road between the travelled way and the object is flatter than 1 on 4, vehicles are able to recover. For this reason, the adjusted offset does not apply nor does it need to be calculated.

Example 2

If a row of light poles was located at the toe of a 1 on 3 embankment, there is an increased likelihood that an errant vehicle would reach the toe of the embankment and impact with the poles. If the offset was 4 m and the distance from the travelled way to the hinge point of the slope was 1 m then:

- \( E_S = 0.17 \)
- \( \text{Adjusted offset} = (0.17 \times 4) + 1 = 1.7 \text{ m} \)

If further investigation is desired to determine sensitivity of design parameters, then the RISC software should be used.

G.1.7 Determine Severity Index (SI) for object

Additions

The probability that an object will be hit is a function of its size. The fixity of an object affects the consequence of the impact. In this chapter, objects with high severity are those likely to cause moderate to severe injuries to occupants, including death. The extent of injury is also related to the speed of impact.

The term “Severity Index” (SI) is used to assign a weighted severity to an object. It is a measure of the expected severity outcome of an impact with the object; the severity index scale ranges from 0 to 10. An SI of zero anticipates a crash that involves no significant property damage or injury. At the other extreme, an SI of 10 anticipates a crash with a 100% probability of a fatality. Between these extremes, Severity Indices (SIs) reflect the relative contribution of other crash outcomes, based on the relationships outlined in *Guide to Road Design* Table 4.8. It is important to note that the SI represents an average severity and not a worst case impact.

Severity indices will vary with the type of vehicle involved, its speed and the type of object impacted. The tables in *Guide to Road Design* Appendix E may be used as a guide. The selection of a SI is relatively subjective and local knowledge may be used to adjust this figure.

G.1.9 Option evaluation and prioritisation

There is no equivalent Section G.1.9 in *Austroads Guide to Road Design - Part 6*.

New

Quantitative evaluation

Benefit cost analysis is a method that estimates the benefits derived from a specific course of action compared to the costs of implementing that action. If the estimated benefits of a specific design exceed the cost of constructing and maintaining that design over a period of time, the safer design may be implemented. However, simply having a benefit/cost ratio greater than one may not in itself provide justification for the construction of a roadside safety treatment. Each project must compete with others for limited safety funds. It should be noted that the accompanying “RISC software automates this process, supplying benefit to cost ratios for each treatment option.
The primary benefit obtained from selecting one design over another is the expected reduction in future crash costs. These typically include property damage costs and personal injury costs. In some cases, the total number of crashes may be reduced by a given treatment, such as providing a significantly wider roadside recovery area than previously existed. In other instances, the safety treatment may not reduce the total number of crashes but may reduce their severity (e.g. the installation of a median barrier).

A benefit/cost analysis must consider the period of time (project life) over which each alternative treatment provides a benefit. Since different treatments can have different project lives, both benefits and costs must be annualised so direct comparisons between alternative treatments can be made. To reduce total (life cycle) costs to annualised costs, discount rates must be considered. An annualised benefit/cost ratio thus compares the expected savings to society (through reduced crash costs) to the costs (construction and maintenance) incurred to provide a specific treatment.

The following is a brief summary of the basic methodology for calculating benefit/cost ratios.

The benefit/cost ratio (BCR) is defined as the Net Present Benefit (NPB) divided by the Net Present Cost (NPC) (Equation 2).

\[
BCR = \frac{NPB}{NPC}
\]

The NPB is defined as the total value of benefits due to crash reduction over a defined period based on an economic discount rate (NPB).

\[
NPB = (\text{factor}) \times B
\]

Where:

- (factor) is a discounting factor, for different values of rate and period, and
- B is the value of annual benefits (i.e. annual reduction in road crash cost).

The NPC is defined as the cost of implementation (discounted if not undertaken in the first year).

Factors required for the determination of a BCR are:

- cost savings in crashes prevented or reduced severity (reduction in road crash cost)
- cost of implementing treatment
- cost of maintaining treatment
- cost of repairing treatment if hit
- length of analysis period, and
- discount rate.

A BCR greater than 1.0 demonstrates an overall economic benefit. Economic benefits increase with increasing BCR. The actual BCR that determines if a road safety barrier is appropriate for site specific circumstances will be determined at project or program level.

Existing sites that are candidates for retrofit treatment should be scheduled for implementation in priority order depending on BCR and crash history.
**RISC software methodology**

The modelling method can be used to determine the possible BCR achievable by comparing the treatment options available. For example, an economic comparison can be made between leaving an end-on culvert as is, installing bar grates, redesigning the culvert end wall to reduce its severity, and the installation of guardrail.

Once a roadside object is identified as a potential hazard, the risk can be analysed. The methodology and processes adopted by the RISC software for determining the impact frequency of errant vehicles and calculating risk is outlined in the following section (the calculations following are automated somewhat when entering the data into RISC). Figure G1 in the *Austroads Guide to Road Design – Part 6* illustrates this process.
Appendix H – Treatments for brownfield sites

Additions
Refer to Transport and Main Roads Guide to Road Design in Brownfield Sites document.

H.3.1 Location on embankments

Differences
Austroads Guide to Road Design Figure H 2 “Post on embankment slope” (figure panels 4, 5 and 6) are not accepted unless justified through a fully documented design exception process.

H.3.2 Location on urban footway corners

Not Accepted
Section H.3.2 of the Austroads Guide to Road Design – Part 6 is not accepted for this section. Specifically the guidance provided in Figure H 3 of the Austroads Guide to Road Design – Part 6 is considered unacceptable.

H.4 Wire rope barrier in narrow medians

Differences
Table H 1 should be considered informative. The actual deflection values for wire rope safety barrier are product specific and should be obtained from the supplier.

The Transport and Main Roads Guide to Road Design in Brownfield Sites document recommends that wire rope barriers should not be installed in median narrower than 1.5 m.
Appendix I – Examples of length of need calculations

I.1 General

Differences
The ‘angle of departure’ method is not accepted.

I.3 Angle of departure method

Not Accepted
Section I.3 of the Austroads Guide to Road Design – Part 6 is not accepted for this section.

I.4.1 Example 1

Difference
Section I.4.1 of the Austroads Guide to Road Design – Part 6 is accepted for this section, but only the ‘run out length’ method. The ‘angle of departure’ method is not accepted.

I.4.2 Example 2

Difference
Section I.4.2 of the Austroads Guide to Road Design – Part 6 is accepted for this section noting that the angle of departure’ method is not accepted.
Appendix J – Types of safety barrier terminals

Refer to Transport and Main Roads documentation for approved *Road Safety Barriers and End Treatments* and *Standard Drawings Roads Manual* for construction and layout standards.

J.1.1 Specific gating end treatments

*Differences*

The “leading slotted break away cable terminal (SBCT) is not accepted.

*Additions*

Supplier’s design and installation manuals should be consulted for proprietary terminals that are accepted.
Appendix K – Transitions between barrier types

Refer to Transport and Main Roads documentation for approved Road Safety Barriers and End Treatments and Standard Drawings Roads Manual for construction and layout standards.

K.5 W-beam to concrete

*Additions*

The direct connection of w-beam to concrete is discouraged and should not be accepted for new installations. A transition from w-beam to thrie-beam to concrete is the preferred method of interfacing w-beam to a rigid barrier system in all situations.

K.7 Wire rope safety barrier to semi-rigid barrier

*Differences*

Figure K 1 is not accepted.

*Additions*

The 'points of redirection' for two overlapping barriers must be in line perpendicular to the lane edge line.

K.8 Wire rope safety barrier to concrete barrier

*Additions*

Figure K 2 is accepted however the design needs to consider the direction of travel. The 'points of redirection' for two overlapping barriers must be in line perpendicular to the lane edge line.
Commentary 10

Differences

The design numbers in the text of Commentary 10 in the Austroads Guide to Road Design - Part 6 are not mandatory.
Commentary 12

Differences

In Section C12.1 of the Austroads Guide to Road Design – Part 6, reference is made to Figure 12.4 where the barrier is located in the “not recommended” zone. In these conditions, where the barrier is located on an embankment, behind a kerb or on the up-slope of a median, the installation is the subject of a design exception. The Transport and Main Roads ‘Guide to Road Design in Brownfield Sites’ document should be consulted for more information.

In Section C12.2 of the Austroads Guide to Road Design – Part 6, the department does not accept that barriers can be placed beyond the hinge point unless justified through a fully documented design exception process.