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Road Planning and Design Manual
Edition 2: Volume 3

Supplement to Austroads Guide to Road Design Part 6: Roadside Design, Safety and Barriers

November 2023

Queensland Government

Translating and interpreting assistance

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Feedback

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Relationship with Austroads Guide to Road Design – Part 6 (Edition 4.0 2022)

The Department of Transport and Main Roads has, in principle, agreed to adopt the standards published in the Austroads *Guide to Road Design* (2022) *Part 6: Roadside Design, Safety and Barriers*.

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

- *Road Planning and Design Manual* (RPDM)
- *Queensland Guide to Traffic Management* (QGTM)
- *Queensland Manual of Uniform Traffic Control Devices* (Queensland MUTCD)
- *Traffic and Road Use Management Manual* (TRUM).

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:

1. has precedence over the *Austroads Guide to Road Design – Part 6* when applied in Queensland
2. details additional requirements, including *accepted with amendments* (additions or differences), *new* or *not accepted*
3. 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:

Accepted:	Where a section does not appear in the body of this supplement, the *Austroads Guide to Road Design – Part 6* is accepted.
Accepted with amendments:	Part or all of the section has been accepted with additions and or differences.
New:	There is no equivalent section in the Austroads Guide.
Not accepted:	The section of the Austroads Guide is not accepted.

Section		Title	Queensland application	Dept contact*
1.	**Introduction to Roadside Design**			
	1.1	Context Sensitive Designs	Accepted with amendments	Road Design
	1.2	Purpose	Accepted with amendments	Road Design
	1.3	Reading this Part in the Context of Part 1	Accepted	Road Design

Section		Title	Queensland application	Dept contact*
	1.4	Scope of this Part	Accepted with amendments	Road Design
	1.5	Principles Considered in Roadside Design to Achieve the Safest System	Accepted	Road Design
	1.6	Roadside Safety Design	Accepted	Road Design
	1.7	Terminology	Accepted with amendments	Road Design
	1.8	Overview of the Roadside Risk Assessment Process	Accepted	Road Design
	1.9	Calculating a Risk Score	Accepted with amendments	Road Design
2.	**Network Risk Assessment**			
	2.1	General	Accepted	Road Design
	2.2	Corridor Safety Visions	Accepted with amendments	Safer Roads
	2.3	Treatment of Roads Based on Policies and Practices	Accepted with amendments	Safer Roads
	2.4	The Network Roadside Risk Intervention Threshold (NRRIT)	Accepted with amendments	Safer Roads / Road Design
	2.5	Example of Setting a NRRIT	Accepted	Road Design
3.	**Program and Project Risk Assessment**			
	3.1	Overview of the Risk Evaluation Process	Accepted	Road Design
	3.2	Concepts Used in Evaluating the Risk at Particular Sites	Accepted	Road Design
	3.3	Step 1: Assess Against National Practices, Jurisdictional Policies and Corridor Visions	Accepted	Road Design
	3.4	Step 2: Compare the Risk Score with the NRRIT	Accepted with amendments	Road Design
	3.5	Step 3: Identify, Evaluate and Rank Risk Mitigation Options	Accepted	Road Design
	3.6	Step 4: Design the Recommended Roadside Treatments	Accepted with amendments	Road Design
4.	**Treatment Options**			
	4.1	General	Accepted	Road Design
	4.2	Summary of Treatment Options	Accepted	Road Design

Section		Title	Queensland application	Dept contact*
	4.3	Effectiveness of Treatment Options	Accepted	Road Design
	4.4	Treatments for Different Hazards	Accepted with amendments	Road Design
5.	**Fundamentals of Safety Barrier Systems**			
	5.1	General	Accepted	Road Design
	5.2	The Evaluation of Barriers and Safety Devices	Accepted with amendments	Road Design
	5.3	Barrier Flexibility	Accepted with amendments	Road Design
	5.4	Barrier Configurations	Accepted	Road Design
	5.5	Barrier System Performance Measures	Accepted	Road Design
	5.6	Terminals and Crash Cushions	Accepted	Road Design
	5.7	Transitions and Overlaps	Accepted with amendments	Road Design
	5.8	Barriers for Heavy Vehicles	Accepted	Road Design
	5.9	Barriers for Motorcyclists	Accepted	Road Design
	5.10	Barriers for Pedestrians and Cyclists	Accepted	Road Design
	5.11	Barriers in Narrow Medians	Accepted	Road Design
	5.12	Continuous Barriers	Accepted	Road Design
	5.13	Road or Route Containment Level	Accepted with amendments	Road Design
	5.14	Choosing and Appropriate Barrier	Accepted	Road Design
6.	**Road Safety Barriers**			
	6.1	Introduction	Accepted	Road Design
	6.2	Road Safety Barrier Design Process	Accepted	Road Design
	6.3	Collect Site information (Step 1)	Accepted	Road Design
	6.4	Determine the Objectives of the Proposed Safety Barrier (Step 2)	Accepted	Road Design
	6.5	Determine the Containment Level for the Proposed Barrier (Step 3)	Accepted	Road Design

Section		Title	Queensland application	Dept contact*
	6.6	Identify Barriers that Meet the Objectives and Containment Level (Step 4)	Accepted with amendments	Road Design
	6.7	Select a Barrier System and Define its Working Width (Step 5)	Accepted	Road Design
	6.8	Define the Constraints on the Lateral Position of the Barrier (Step 6)	Accepted with amendments	Road Design
	6.9	Determine the Longitudinal Location of a Barrier (Step 7)	Accepted	Road Design
	6.10	Evaluation of the Selected Barrier (Step 8)	Accepted	Road Design
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	6.12	Structural Design of the Proposed Barrier (Step 10)	Accepted	Road Design
	6.13	Detailed Installation Refinements (Step 11)	Accepted with amendments	Road Design
	6.14	Select End treatments to Longitudinal Barriers (Step 12)	Accepted	Road Design
	6.15	Access Through Barriers	Accepted	Road Design
	6.16	Continuous Barriers on the Verge	Accepted	Road Design
	6.17	Vulnerable Road Users	Accepted with amendments	Road Design
	6.18	Two-stage Shielding	Accepted	Road Design
	6.19	Barriers Across Drainage Structures and to Avoid Underground Conflicts	Accepted	Road Design
	6.20	Protecting Critical Infrastructure Close to Barriers	Accepted with amendments	Road Design
	6.21	Fauna Crossings	Accepted	Road Design
	6.22	Installation of Concrete Barriers on Superelevated Roads and Stepped Medians	Accepted	Road Design
	6.23	Aesthetic Road Safety Barriers	Accepted with amendments	Road Design
	6.24	Additional Barrier Design Requirements	Accepted with amendments	Road Design
	6.25	Develop a Plan to Maintain the Barrier (Step 14)	Accepted	Road Design
	6.26	Confirm that the Barrier Meets the Objectives (Step 15)	Accepted	Road Design
	6.27	Documentation of the Design (Step 16)	Accepted	Road Design

Section		Title	Queensland application	Dept contact*
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	7.3	Frangible Sign Posts	Accepted	Road Design
	7.4	Permanent Bollards	Accepted	Road Design
	7.5	Security Bollards	Accepted	Road Design
	7.6	High Profile Kerbs and Low Profile Barriers	Accepted	Road Design
	7.7	Traversable Culvert End treatments	Accepted	Road Design
	7.8	Audio Tactile Line Marking	Accepted	Road Design
8.	Roadside Design for Steep Downgrades			
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	8.2	Containment Facilities	Accepted	Road Design
	8.3	Warrants for Investigation	Accepted	Road Design
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	8.5	Key Design Considerations	Accepted with Amendments	Road Design
	8.6	Design Process	Accepted	Road Design
9.	Work Zone Safety Barrier Systems		Accepted with Amendments	Road Design
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Appendices				
Appendix A	Terminology		Accepted with Amendments	Road Design
Appendix B	Detailed Risk Evaluation Procedure		Accepted with Amendments	Road Design
Appendix C	Treatment of Roads Based on Jurisdictional Polices		Accepted with Amendments	Road Design
Appendix D	Risk Score Charts		Accepted	Road Design

Section	Title	Queensland application	Dept contact*
Appendix E	Cost of Impacts	Accepted with Amendments	Road Design
Appendix F	Likely Impact Conditions and Consequences	Accepted	Road Design
Appendix G	Length of Need	Accepted with Amendments	Road Design
Commentary			
Commentary 1		Accepted	Road Design
Commentary 2		Accepted	Road Design
Commentary 3		Accepted	Road Design
Commentary 4		Accepted	Road Design

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- Safer Roads, Safer Roads Infrastructure, Engineering and Technology, Transport and Main Roads email: saferroads@tmr.qld.gov.au

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1 Introduction to roadside design

1.1 Context Sensitive Designs

Addition

Refer to the Transport and Main Roads *Road Planning and Design Manual* (RPDM) Volume 3, Part 1 for additional guidance regarding context sensitive designs.

1.2 Purpose

Addition

The purpose of RPDM 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, economic 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.

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.

1.4 Scope of this Part

Difference

This part 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 the practitioner may need to consider what is outside the road corridor.

Addition

This document contains additional scope, as provided in Table 1.4 below.

Table 1.4 – RPDM Volume 3, Part 6 additional scope items

Additional Scope Items	Reference
Design of motorcycle protection systems	Section 6.17.1
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	Queensland Rail Specification *MD-20-40 Civil – Road / Rail Interface Barriers*

1.7 Terminology

Difference

In instances of conflict, definitions in the RPDM Volume 3, Part 6 take precedence over definitions in the *Austroads Guide to Road Design – Part 6*.

1.9 Calculating a risk score

Addition

The new risk evaluation process detailed in this document and the *Austroads Guide to Road Design – Part 6* is the default requirement for use on state-controlled roads. The project sponsor may however choose to approve the use of an alternate process such as 'generalised hazard assessment process' if considered more appropriate in context. The design report should document this decision and the details of the alternate risk assessment / evaluation process.

The simplified process described in this section of the *Austroads Guide to Road Design – Part 6* is accepted, noting the limitations outlined in Section 1.9.12.

1.9.5 Operating and design speed

Addition

Refer to the Transport and Main Roads RPDM Volume 3, Part 3 for additional guidance regarding speed parameters.

1.9.13 Hazards for motorcyclists and other vulnerable road users

Addition

Refer to Transport and Main Roads *Traffic and Road Use Management Manual* (TRUM) Volume 3, Part 5 for Queensland-specific definitions of non-hazardous fixed objects.

2 Network risk assessment

2.2 Corridor safety visions

Difference

iRAP Star Ratings are not used in the development of corridor safety visions in Queensland.

Addition

The Department of Transport and Main Roads – Safer Roads Unit should be contacted for additional guidance regarding Network Safety Plans.

2.3 Treatment of roads based on policies and practices

2.3.1 Treatment of roads based on national practices

Not accepted

Section 2.3.1 of the *Austroads Guide to Road Design – Part 6* is not accepted. Treatments based on Queensland-specific jurisdictional policies are outlined in Section 2.3.2.

2.3.2 Treatment of roads based on jurisdictional policies

Addition

Queensland-specific mandatory treatments are:

- All new installations of road safety barriers (including terminals) shall be fitted with motorcyclist injury countermeasures, such as rub rail, suitable to the barrier type, taking into consideration fauna movements.
- Rural roads with Annual Average Daily Traffic (AADT) greater than 4,000 vehicles per day, shall have a 1 metre Wide Centre Line Treatment (WCLT) including Audio Tactile Line Marking (ATLM).
- For all divided roads with posted speed greater than or equal to 80 kilometres per hour, medians shall be clear of all hazards unless protected by roadside barrier.
- For all divided roads, with design AADT greater than 10,000 vehicle per day and with posted speed greater than or equal to 80 kilometres per hour, physical separation by median barrier shall be provided.
- ATLM shall be installed on edge lines and centre lines on all rural roads, with sealed shoulder greater than 0.5 metres.
- Mandatory requirements at road / rail interfaces on the state-controlled road network are contained in the Queensland Rail Specification *MD-20-40 Civil – Road / Rail Interface Barriers*.

2.4 The Network Roadside Risk Intervention Threshold (NRRIT)

Addition

> The new risk evaluation process detailed in this document and the *Austroads Guide to Road Design – Part 6* is the default requirement for use on state-controlled roads. The project sponsor may however choose to approve the use of an alternate process such as 'generalised hazard assessment process' if considered more appropriate in context. The design report should document this decision and the details of the alternate risk assessment / evaluation process.

The NRRIT value to be used is 0.6. This value was chosen based on analysis using hypothetical scenarios. Regarding the chosen NRRIT value, Transport and Main Roads values your feedback. Feedback should be directed to the Safer Roads and Road Design Units'.

If the Risk Score at a given site is computed to be above the NRRIT then a treatment to improve road safety is warranted.

In some instances, after treatment, the Risk Score may remain above the NRRIT. If the Risk Score of a proposed treatment is higher than the NRRIT but significantly less than the Risk Score of the hazard(s), engineering judgement should be applied. Presently, in these instances, the decision to retain a Risk Score above the NRRIT is subject to the 'design exception' process and documentation requirements.

For the oncoming vehicle head on crash risk on divided or undivided roads and when the Transport and Main Roads Road Safety Policy does not apply, the risk should be assessed using engineering judgement.

3 Program and project risk assessment

3.4 Step 2: Compare the risk score with the NRRIT

3.4.1 Adverse crash history

Addition

Sites with a crash history should be evaluated in accordance with the *Austroads Guide to Road Safety – Part 2*.

3.6 Step 4: Design the recommended roadside treatments

Addition

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

4 Treatment options

4.4 Treatments for different hazards

4.4.4 Treatments for embankment slopes

Difference

Queensland uses the convention 1(V) on X(H) to describe a batter slope as for example 1 on 10.

Installing a barrier on an embankment steeper than 1 on 10 is considered outside normal design domain.

4.4.5 Treatment for drains

Addition

Section 4.4.5 of the *Austroads Guide to Road Design – Part 6* is to be considered informative, for this section as treatments for drains need to be designed in accordance with the Transport and Main Roads *Road Drainage Manual* (RDM).

4.4.6 Treatments for culverts

Addition

Section 4.4.6 of the *Austroads Guide to Road Design – Part 6* is to be considered informative, for this section as treatments for drains need to be designed in accordance with the RDM.

4.4.11 Treatments for sign gantries, sign cantilever supports and bridge piers

Addition

Refer to Transport and Main Roads *Design Criteria for Bridges and Other Structures* for guidance regarding sign gantries, sign cantilever supports and bridge piers.

5 Fundamentals of safety barrier systems

5.2 The evaluation of barriers and safety devices

5.2.1 Australian and New Zealand Standard AS/NZS 3845

Addition

The Department of Transport and Main Roads has adopted AS/NZS 3845.1 and AS/NZS 3845.2 test standards for crash testing of barriers and end treatments.

Refer to the *TMR Accepted Road Safety Barrier System and Devices* for the current list of accepted products and conditions.

5.3 Barrier flexibility

5.3.2 Operation of different barrier types

Addition

Permanent concrete barriers

Transport and Main Roads permanent concrete barrier systems are shown in Standards Drawing Concrete barriers and guardrails.

Research papers and in-service experience have validated that small, front wheel drive vehicles have a tendency to "barrel roll" when hitting F-shape barriers, particularly at speeds approaching 80 km/h.

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

Drainage should be checked and appropriate drainage installed to prevent ponding.

Height of permanent concrete barrier

Public domain permanent concrete barriers can be different heights. Refer to the Department of Transport and Main Roads' Standard Drawings for additional details. 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 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.
3. Luminaire supports on new works cannot be located on top or within single slope concrete barriers lower than 1100 mm high.

Table 5.3.2 –Standardised heights for permanent single slope concrete barrier

Single Slope Concrete Barrier Height	Containment Level	Notes
820 mm	TL-3	Containment level will be reduced if pavement height increases.
920 mm	TL-4	Containment level will be reduced if pavement height increases.
1100 mm	TL5	Allows for future increase in pavement of 35 mm. Containment level will be reduced if pavement height increases more than 35 mm.

Conventional non-proprietary w-beam barriers (legacy systems)

Replace the 1st sentence of the 1st paragraph with:

These barriers, with stiffer posts and w-beams or thrie-beams, are able to resist the loads generated in the impact in a localised area.

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 transitions to roadside barriers. Refer to *Austroads SBTA 21-005 Public domain transition from strong-post to ridged concrete barrier* and or the Department of Transport and Main Roads Standard Drawings for additional details.

  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.

5.7 Transitions and overlaps

5.7.1 Transitions

Addition

W-beam to permanent concrete barrier

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 permanent concrete barrier system in all situations.

5.13 Road or route containment level

5.13.1 Choosing an appropriate minimum containment level

Addition

For all road projects, a design development 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 Road safety barriers

6.8 Define the Constraints on the Lateral Positions of the Barrier (Step 6)

6.8.1 Offset from the traffic lane

Difference

The application of the design domain concept in this section is not accepted but is recommended.

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. Operational and maintenance requirements may require a larger offset from the traffic lane.

6.8.3 Minimum lateral distance of a barrier from an embankment hinge point

Addition

The Normal Design Domain (NDD) for the lateral placement of road safety barriers is achieved when the hinge point is located outside of the deflection width of the road safety barrier. Extended Design Domain (EDD) applies when the hinge point is located within the deflection width of the road safety barrier. This can include situations where the safety barrier is located on the hinge point, subject to proprietary systems minimum lateral distance requirement. Minimum lateral distance should be obtained from the supplier of the system and detailed design based on site specific circumstances.

6.8.7 Location of barriers in narrow medians

Difference

Table 6.8: 'Design criteria for barriers in different median widths' in the *Austroads Guide to Road Design – Part 6* is not accepted and is replaced with Table 6.8.7 below.

Table 6.8.7 – Median width comparison for NDD and design exception

NDD / Design Exception	Minimum median width
NDD	System width + 2 × deflection width*
Design Exception	1.5 m minimum

* The road safety barrier system is not permitted to deflect into the traffic lane. For product specific information refer to *TMR Accepted Road Safety Barrier Systems and Devices*.

The road safety barrier system product, type and performance characteristics should be carefully evaluated and documented. Not all products are equally effective in narrow medians even though they have the same test level rating.

There are many factors to be considered in the planning and design of median barriers. The list below provides some of the factors to be considered:

- expected impact rates
- pavement width, geometry and sight distance
- existing road conditions and environment (speed, utilities, drainage, property, accesses, intersections, overtaking opportunities and so on)
- road context and traffic volumes
- curve widening and vehicle tracking
- combination of minimum design values
- minimum width between barriers for operational requirements such as during events where emergency services are required
- line marking and signing including ATLM
- barrier selection such as relatively less flexible barrier for narrow medians
- minimum length of installation
- minimum vertical curvature
- minimum horizontal curvature
- crossfall and superelevation
- crown line location
- availability of adequate space for anchorages, and/or
- nuisance hits requiring ongoing repair and maintenance.

6.13 Detailed installation refinements (step 11)

6.13.1 Modification of the working width

<u>*Addition*</u>

Reducing the working width

Transport and Main Roads accepts reduced working widths for TL-4 and TL-5 single slope concrete barriers, calculated by taking the ratio of the height of the cab (2.7 m) to the height of the van (4.6 m) resulting in a 0.59 ratio. This is accepted as an EDD in situations where a roadside structure being impacted by the cargo van of a truck is considered acceptable by the asset owner. To confirm the suitability of this EDD approach for individual projects, consult the Transport and Main Roads, Engineering and Technology, Structures Design Review and Standards Unit (et_structures_review_and_standards@tmr.qld.gov.au) or the asset owner.

Where working widths cannot be achieved using the above EDD approach, refer to Technical Note TN209 *Reduced Working Width for Single Slope Concrete Barrier Design*, for Design Exception advice.

6.13.2 Minimum length of barrier system requirements

<u>*Difference*</u>

Practical minimum length of barrier system

The practical minimum length of barrier system quoted in Section 6.13.2 of the *Austroads Guide to Road Design – Part 6* are not accepted. Transport and Main Roads practical minimum length of barrier system are provided in the *TMR Accepted Road Safety Barrier Systems and Devices*.

6.17 Vulnerable road users

6.17.1 Motorcyclists

<u>*Addition*</u>

Design of a motorcycle protection systems (MPS)

For the purposes of this section, a MPS is comprised of all the following motorcycle protection devices (MPD):

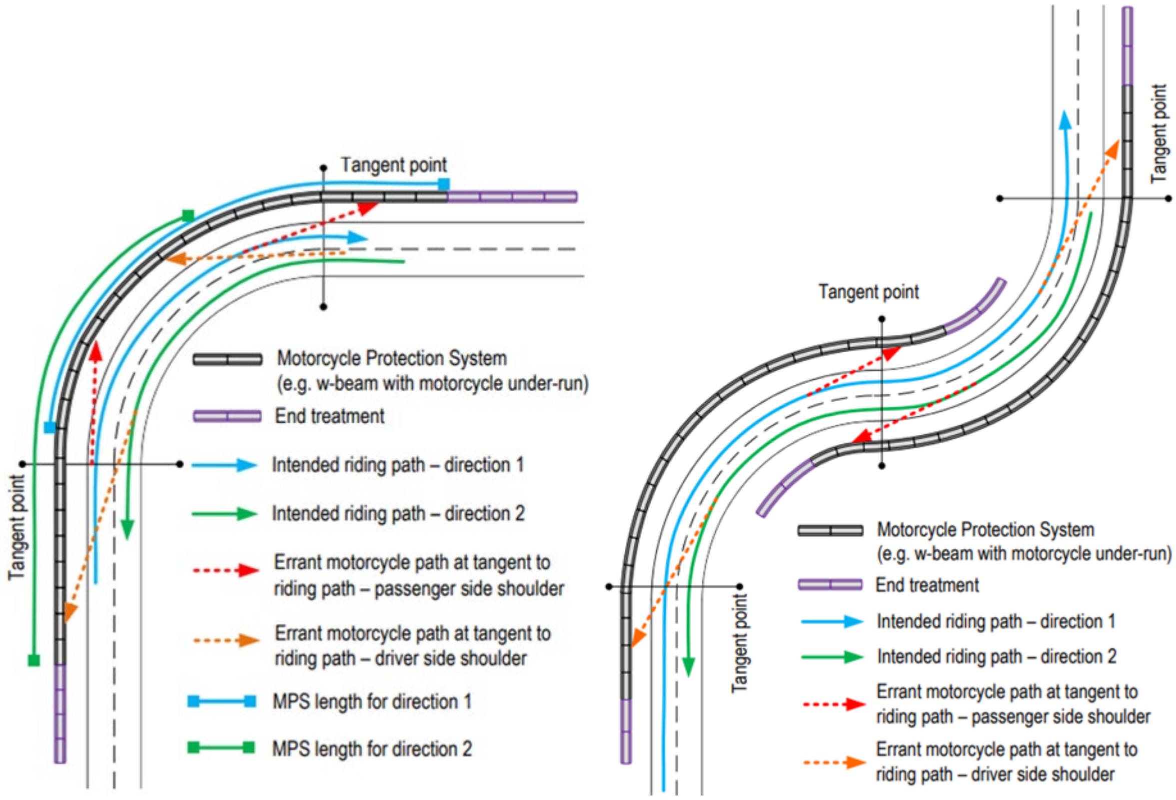
- safety barrier with motorcycle rubrail
- an end treatment with a cover, and
- guardrail post caps and plastic flexible delineators.

Where there is a site-specific risk associated with the provision of motorcyclist rubrail, for example, where a build-up of debris increases the risk to motorcyclists, a site-specific risk assessment is required. It is important to note that a solution developed for one site may not be appropriate for another site. A break in the rubrail may form part of the mitigation strategy, which will require justification and need to be documented in the design development report. Refer to Section 6.21 for additional guidance regarding fauna crossings.

The layout of an MPS should cater for errant motorcyclists departing on the passenger and driver's shoulder, this includes crossing the opposing lane on a two-lane, two-way road. An example of the MPS layout required to provide protection for departures on the passenger or driver shoulders from both directions of travel is provided in Figure 6.17(a), this is also applied on a reverse curve in Figure 6.17(b).

On a substandard curve (as per MUTCD Part 2) and or on an out-of-context curve (as per the notes to Figure 6.17(b)) the MPS is required to be extended for the length of the curve and past the tangent point as per the method provided in Figure 6.17(c). An example application of this is provided on a winding section of road in Figure 6.17(c). This approach could be applied to other curve types, however, the length of hazard on the shoulder and the resulting increase in exposure for the length of the curve should be considered.

Figure 6.17(a) – MPS layout required for a substandard curve and reverse curve



Notes for Figure 6.17(a):

1. On a substandard curve or series of curves with an irregular course, end treatments should not be placed where an errant motorcycle may depart during or exiting a cornering manoeuvre.
2. The MPS layout should:
   a. consider an errant motorcyclist from direction 1 and 2, and
   b. extend along the length of the curve and past the tangent point (Figure 6.17(c)) on the curve exit to ensure an end treatment is outside of an errant motorcycles path.

An out-of-context curve may include one or more of the following:

- The longitudinal downgrade (in the direction of travel) is steeper than 4% when combined with a small radius or irregular curves, or steeper than 6% on any curve radius or curve type.
- Irregular curves such as compound curve, broken back curve with varying radii (from either direction of travel) or hairpin turns. These do not have to be substandard curves and do not need to meet the criteria in the next point.

- In the direction of travel a curve within reverse curve, compound curve or a series of curves that requires a speed reduction of more than 10 km/h from the operating speed of the previous straight or curve. Refer RPDM Vol 3, Part 3 and *Austroads Guide to Road Design – Part 3* to determine an estimate operating speed for curves within a series of curves.

Figure 6.17(b) – Length to extend MPS past the tangent point on curve exits

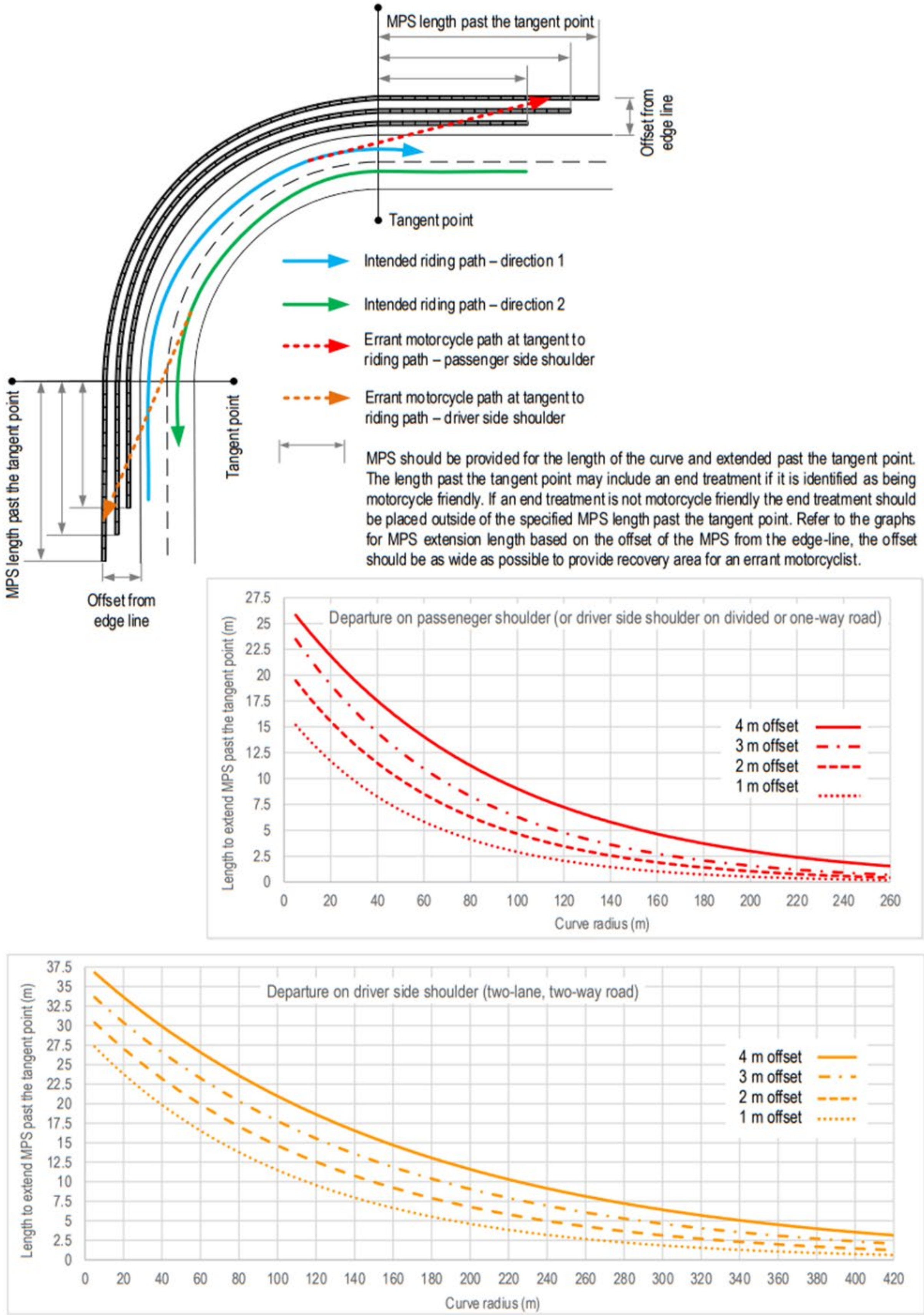
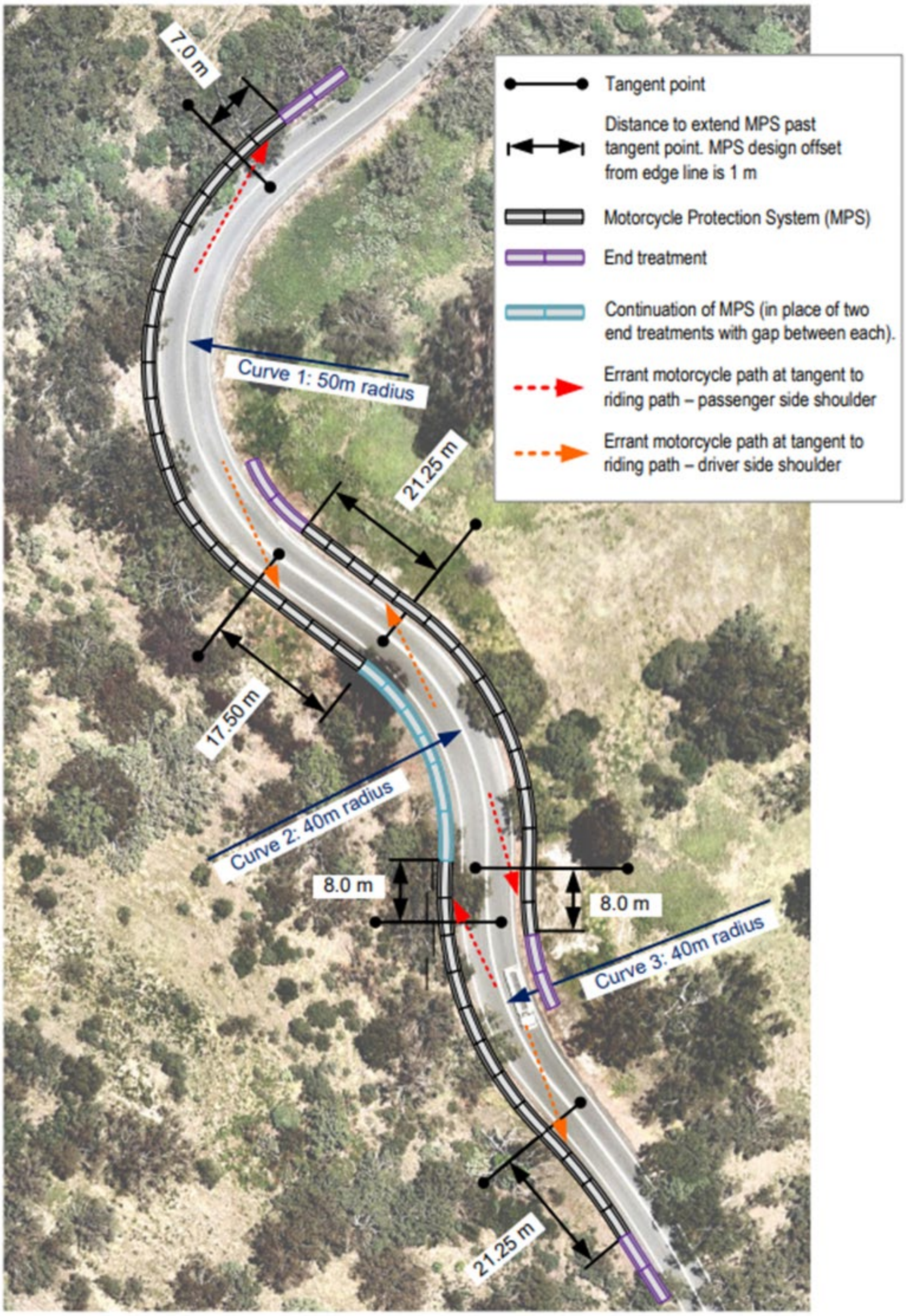


Figure 6.17(c) – Example of MPS layout and MPS total length through a series of curves



6.20 Protecting Critical Infrastructure Close to Barriers

6.20.2 Gantries and Bridge Piers

Difference

Austroads *Guide to Road Design* Part 6: *Roadside Design, Safety and Barriers* recommends a factor of safety of 1.2 for gantries and bridge piers, however the guide is silent for other structures. Where assets that could be impacted are involved, consult the Transport and Main Roads, Engineering and Technology, Structures Design Review and Standards Unit (et_structures_review_and_standards@tmr.qld.gov.au) to confirm the appropriate factor of safety value.

6.20.4 Noise barriers

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

6.21 Fauna crossings

Addition

Where there is a site-specific risk associated with the provision of motorcyclist rubrail, for example, where wildlife may become trapped on the roadway, a site-specific risk assessment is required. A break in the rubrail may form part of the mitigation strategy, which will require justification and need to be documented in the design development report.

6.23 Aesthetic road safety barriers

Addition

Section 6.23 of the *Austroads Guide to Road Design – Part 6* is accepted 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 3845.1 prior to approval for use at any particular site.

6.24 Additional barrier design considerations

6.24.9 Maintenance of barriers

Addition

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 of Transport and Main Roads through its Regions should:

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

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, including the tension of wire rope safety barriers. 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).

7 Installation of other roadside safety devices

7.2 Frangible posts and masts

7.2.1 General

Addition

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:

- a pole located as far as possible from the travelled way
- a pole provided with a breakaway or frangible design where appropriate, also located as far from the travelled way as possible

- locate pole behind any existing road safety barrier, or
- treat the pole, for example:
  - make the pole a breakaway or frangible design where appropriate
  - provide a road safety barrier if required, or
  - 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.

Poles should not be erected at locations where there is a greater impact risk, such as:

- 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.

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.

7.2.3 Energy absorbing poles

Difference

'Energy absorbing' poles are not included in the 'frangible' pole category. Energy absorbing poles are a separate category of pole type.

Refer to Transport and Main Roads *Traffic and Road Use Management Manual* (TRUM), Volume 3, Part 5 *Design Guide for Roadside Signs* and Standard Drawings for overriding policy and design parameters.

7.2.5 Utility poles

Addition

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

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.

8 Roadside design for steep downgrades

8.5 Key design considerations

Difference

Piles of sand or gravel are not acceptable as 'last chance' devices.

9 Work zone safety barrier systems

Addition

Introduction – Purpose of road safety barriers at road work sites

This section should be read in conjunction with:

Manual of Uniform Traffic Control Devices (MUTCD) (Queensland) and specifically Part 3: *Traffic control for works on roads* thereof.

Work Health and Safety Act 2011 (QLD) (and/or any other current relevant legislation).

AS/NZS 3845.1 *Road Safety Barrier Systems* defines a temporary road safety barrier system as "a road safety barrier system used at roadworks, emergencies or similar situations for limited durations. Its purpose is to redirect an impacting vehicle so as to minimise damage to the vehicle and injury to the occupants, while providing protection for workers or other road users".

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.

General requirements

Design of work sites shall:

- meet the requirements of the *Work Health and Safety Act* 2011 (QLD) (and/or any other current relevant legislation)
- be in accordance with the provisions of the Queensland Manual of Uniform Traffic Control Devices (MUTCD) and specifically Part 3: *Traffic control for works on roads*

- be consistent with the requirements of other parts of this manual, and
- be cognisant of the requirements of the Department of Transport and Main Roads' Technical Specification MRTS02 *Provision for Traffic*.

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 *Work Health and Safety Act* 2011 (QLD) (and/or any other current relevant legislation)?
- 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.

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 *TMR Accepted Road Safety Barrier Systems and Devices*.

Subject to any conditions of acceptance for use imposed by the Department of Transport and Main Roads 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 in accordance with the requirements specified by the supplier / manufacturer of 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.

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 *TMR Accepted Road Safety Barrier Systems and 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
- cost and maintenance factors, and
- sloped end terminals are not acceptable solutions for use on state-controlled roads in Queensland.

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 flare and shy line concepts.

Design Exception

In many projects application of NDD, or even EDD, design criteria may not be practicable for temporary roads and a designer may be left needing to consider design parameters below EDD criteria. Department of Transport and Main Roads recognises that there may be opportunities to consider all geometric design parameters and guidance which may result in cost savings and efficiency improvements for temporary roads.

A technical note TN199 *Guidance for the design of temporary roads* has been prepared based on a review of National and International design guidance as well as consideration of case study examples from previous projects to document a basis and to present opportunities for alternatives on which Design Exceptions may be considered.

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 3845.1 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 3845.1 suggests that part of an action plan for maintenance of safety barrier systems should include the above assessment criteria.

References

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

Addition

AASHTO. (2011). *Roadside Design Guide*. Washington, DC.

Austroads. *Guide to Road Design – Part 6, Roadside Design, Safety and Barriers*, Austroads, Sydney, NSW

Queensland Government (2011). *Work Health and Safety Act*

Standards Australia. AS/NZS 3845.1 *Road safety barrier systems*

Standards Australia. AS/NZS 3845.2 *Road safety devices*

Transport and Main Roads *Design Criteria for Bridges and Other Structures, 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 Standard Drawings Roads, Brisbane, QLD

Transport and Main Roads Technical Note TN199 *Guidance for the design of temporary roads*, Brisbane, QLD

Transport and Main Roads Technical Note TN209 *Reduced Working Width for Single Slope Concrete Barrier Design*, Brisbane, QLD

Transport and Main Roads *TMR Accepted Road Safety Barriers Systems and Devices*, Brisbane, QLD

Transport and Main Roads *Traffic and Road Use Management Manual*, Brisbane, QLD

Transport and Main Roads *Transport Noise Management Code of Practice*, Brisbane, QLD

Appendix A – Terminology

A.1 Vehicle movement terminology

Differences

In instances of conflict, definitions in the RPDM Volume 3, Part 6 take precedence over definitions in the *Austroads Guide to Road Design – Part 6*.

A.2 Road safety barrier terminology

Differences

In instances of conflict, definitions in the RPDM Volume 3, Part 6 take precedence over definitions in the *Austroads Guide to Road Design – Part 6*.

Alternative definitions for various terms may be found in other documents, for example, AS/NZS 3845.1, AS/NZS 3845.2 and Manual for Assessing Safety Hardware (MASH).

A.3 Other terminology and definitions used in this part

Differences

In instances of conflict, definitions in the RPDM Volume 3, Part 6 take precedence over definitions in the *Austroads Guide to Road Design – Part 6*.

Appendix B – Detailed Risk Evaluation Procedure

Addition

> The new risk evaluation process detailed in this document and the *Austroads Guide to Road Design – Part 6* is the default requirement for use on state-controlled roads. The project sponsor may however choose to approve the use of an alternate process such as 'generalised hazard assessment process' if considered more appropriate in context. The design report should document this decision and the details of the alternate risk assessment / evaluation process.

B.1.1 Determine the future traffic flow

The appropriate future year for the traffic volume to be used in the Risk Score calculation should be determined at a project level.

B.4.3 Roadside barriers

Difference

A trauma index of 0.43 should be used when assessing the Risk Score of a roadside barrier as an initial check to determine the feasibility of this treatment.

Appendix C – Treatment of Roads Based on Jurisdictional Policies

Addition

Refer to Section 2.3.2 for Queensland-specific mandatory treatment of roads based on jurisdictional policies.

Appendix E – Cost of impacts

E.1 Determine crash costs

Difference

The crash costs quoted in E.1 are outdated. The Department of Transport and Main Roads – Road Design Unit should be contacted for current figures.

Appendix G – Length of need

Addition

Where there is provision of motorcycle protection systems (for example, rubrail) on substandard curves, see Section 5.3.23 to determine barrier lengths required.