

# Road Planning and Design Manual

2nd edition

Queensland Practice

November 2014

Volume 3 – Guide to Road Design

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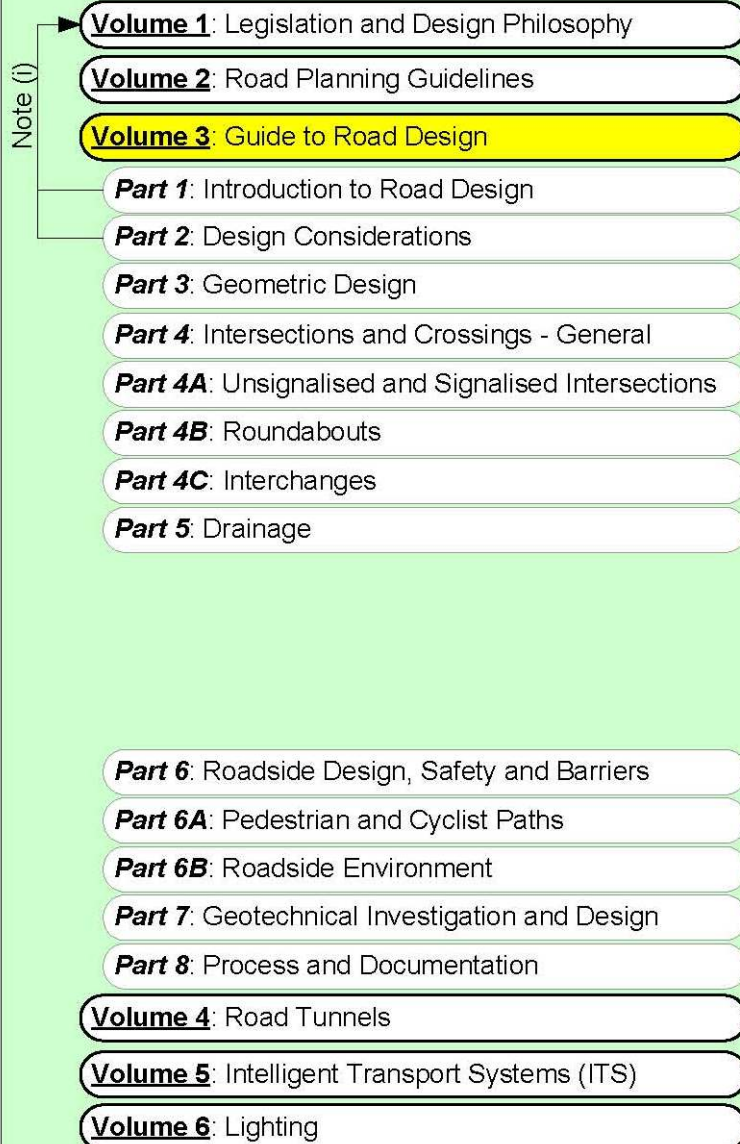
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## Amendment Register

Issue / Rev no.	Reference section	Description of revision	Authorised by	Date
1	All	Initial release of manual (2nd edition)	Steering committee	July 2013
2	4, 4A, 4B & 6	Updated content. Link inserted to access Supplement to <i>Austroads Guide to Road Design</i>	Steering committee	August 2014
3	4C	Updated content. Link inserted to access Supplement to <i>Austroads Guide to Road Design</i>	Steering committee	November 2014

## Road Planning and Design Manual Framework



Notes:

i) Volume 3: Part 1 and 2 refer their contents to Volume 1.

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## **Part 1: Introduction to Road Design**

The *Austrroads Guide to Road Design - Part 1* is accepted.

A wider discussion of the content of *Austrroads Guide to Road Design - Part 1* is included in the *Road Planning and Design Manual (2nd edition) Volume 1 - Legislation and Design Philosophy*.

## **Part 2: Design Considerations**

The *Austrroads Guide to Road Design - Part 2* is accepted.

A wider discussion is included the *Road Planning and Design Manual (2nd edition) Volume 1 - Legislation and Design Philosophy*.

Volume 1 also includes:

- extra information on the Queensland specific approval processes for the use of Extended Design Domain (EDD) and Design exceptions
- an outline of the standard for different classes of roads.

## Part 3: Geometric Design

Further work is required to complete the transition of content from the *Road Planning and Design Manual (1st edition)*, to align with Austroads guides and reflect Transport and Main Roads practice in Queensland. Until then the following guidance applies.

The criteria within the *Road Planning and Design Manual (1st edition)* should be used in lieu of those in the *Austroads Guide to Road Design - Part 3*. This will ensure that no new criteria are introduced that may later be rejected.

The relevant chapters of the *Road Planning and Design Manual (1st edition)* include:

- Chapter 3 – Road planning and design fundamentals
- Chapter 5 – Traffic parameters and human factors
- Chapter 6 – Speed Parameters
- Chapter 7 – Cross Sections
- Chapter 9 – Sight Distance
- Chapter 10 – Alignment Design
- Chapter 11 – Horizontal Alignment
- Chapter 12 – Vertical Alignment
- Chapter 15 – Auxiliary Lanes
- Chapter 20 – Roadside Amenities
- Chapter 22 – Bridges and Retaining Walls, Sections 22.1 and 22.2

Table 1 lists exceptions to the above where particular criteria in the *Austroads Guide to Road Design - Part 3* supersede criteria in the *Road Planning and Design Manual (1st edition)*. All road design schemes should incorporate the *Austroads Guide to Road Design* criteria listed in Table 1.

In some situations, a designer may need to use a less conservative design criterion from the *Austroads Guide to Road Design* that is not listed in Table 1. This need will usually be the result of retrofitting particular geometry at a constrained brownfield site. This is acceptable practice provided the designer adopts the criterion from the *Austroads Guide to Road Design* as a design exception, and documents the need and justification for using it. Please note that some less conservative parameters in the *Austroads Guide to Road Design* should not be adopted (for example, vertical clearances).

Table 2 lists criteria from the *Austroads Guide to Road Design* that should be read in conjunction with the *Road Planning and Design Manual (1st edition)* chapters. These criteria generally provide additional information.

Wherever there is a conflict between the criteria, the *Road Planning and Design Manual* criteria takes precedence.



**Table 1: Criteria in Austroads Guide to Road Design - Part 3 to supersede Road Planning and Design Manual (1st edition) criteria**

Criteria Type	Criteria superseded in the RPDM (1st edition)		Criteria in Austroads Guide to Road Design - Part 3 to adopt
	Chapter	Section	
All Extended Design Domain values	Chapter 4 - Application of Design Principles & Standards	Appendices 4A to 4F	Appendix A - Extended Design Domain for Geometric Road Design
Sight distance criteria	The chapters listed on the previous page	Various	Table 5.1 - Vertical Height Parameters to be applied in all instances of the use of eye and object height.
	Chapter 9 - Sight Distance	Section 9.3.1 - Manoeuvre Sight Distance Section 9.3.2 - Stopping Sight Distance	Sections 5.1 to 5.5 <sup>(1) (2) (3)</sup> Sections 5.7 to 5.11
	Chapter 12 - Vertical Alignment	Section 12.8 - Floodways – only the sentence on stopping sight distance to a height of the water surface at a depth of 150mm	Section 5.2 - Sight Distance Parameters, Table 5.1 - Vertical Height Parameters Water surface at floodways – zero object height. Use of 150mm depth is being considered for use as an EDD value.
	Chapter 15 - Auxiliary Lanes	Section 15.8.1 - Starting and Termination Points	Section 9.9.1 - Starting and Termination Points
Reverse horizontal curves	Chapter 11 - Horizontal Alignment	Section 11.6 - Reverse Curves	Section 7.5.3 - Reverse Curves Appendix E Reverse Curves
Transition curves	Chapter 11 - Horizontal Alignment	Section 11.9 - Transition Curves	Section 7.5.4 - Transition Curves
Horizontal curves with adverse crossfall	Chapter 11 - Horizontal Alignment	Section 11.4.3 - Minimum Superelevation and Adverse Superelevation, excluding the first paragraph	Section 7.8 - Curves with Adverse Crossfall
Crest and Sag Vertical Curves	Chapter 12 - Vertical Alignment	Section 12.3.3 - Crest Curves Section 12.3.4 - Sag Curves	Section 8.6.3 - Crest Vertical Curves Section 8.6.4 - Sag Vertical Curves Section 8.6.5 - Sight Distance Criteria (Sag) <sup>(4)</sup>
Performance of heavy vehicles on grades	Chapter 15 - Auxiliary Lanes	Figure 15.1 - Determination of Truck Speeds on Grade	Figures 9.3 to 9.6

## Notes:

- (1) All reaction times in Table 5.2 are used in Queensland as appropriate according to the conditions listed in the table.
- (2) Desirable values of stopping sight distance for major highways and freeways (using  $d = 0.26$ ) in Table 5.4 generally apply to major multi-lane roads in flat to undulating terrain where there are no constraints to achieving these values. These are not desirable minimum values. In more constrained locations on these roads, the stopping sight distances for  $d = 0.36$  are appropriate.
- (3) Sight distance for trucks must now be provided in all road designs.
- (4) Appearance criterion for sag vertical curves (discussed in Section 8.6.4) should be in accordance with the values in Table 8.6 (as per crest vertical curves).

**Table 2: Criteria in the Austroads Guide to Road Design – Part 3 to be used as Additional Reference Material to that in the Road Planning and Design Manual (1st edition)**

Criteria Type	Criteria in the <i>RPDM (1st edition)</i>		Additional criteria in <i>Austroads Guide to Road Design – Part 3</i>
	Chapter	Section	
Public Transport / HOV lanes	Chapter 7 - Cross Section	Section 7.2.12 - Transit Lanes	Section 4.9 - High Occupancy Vehicle Lanes <sup>(1)</sup>
		None	Section 4.12 - Bus Stops
Cyclist treatments <sup>(2)</sup>	Chapter 7 - Cross Section	Section 7.2.10 - Cycleways (Lanes) Section 7.3.8 – Cycleways (Shoulders)	Section 4.8 - Bicycle Lanes
On-street parking	Chapter 7 - Cross Section	Section 7.2.8 - Parking Lanes and Section 7.7.6 - Parking Lane Crossfall	Section 4.10 - On-street Parking

Notes

(1) Reference the 'Policy on Managed Motorways' for the policy position for HOV lanes on motorways. This policy can be obtained from the Road Operations Section, Engineering and Technology Branch of the Department of Transport and Main Roads.

(2) The *Austroads Guide to Road Design - Part 6A* should be used for information on cyclist treatments. Also refer to the table of exceptions (Table 1) published under 'Cycling Infrastructure Policy' on the Transport and Main Roads website at: [www.tmr.qld.gov.au/Travel-and-transport/Cycling/Cyclists](http://www.tmr.qld.gov.au/Travel-and-transport/Cycling/Cyclists).

## **Part 4: Intersections and Crossings – General**

See [Supplement to Austroads Guide to Road Design – Part 4: Intersections and Crossings - General](#)

## **Part 4A: Unsignalised and Signalised Intersections**

See [Supplement to Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections](#)

## **Part 4B: Roundabouts**

See [Supplement to Austroads Guide to Road Design – Part 4B: Roundabouts](#)

## **Part 4C: Interchanges**

See [Supplement to Austroads Guide to Road Design – Part 4C: Interchanges](#)

## **Part 5: Drainage**

Drainage criteria are covered in the Department of Transport and Main Roads, *Road Drainage Manual (2nd edition)*.

The current version of the *Austrroads Guide to Road Design - Part 5, 5A, and 5B* can be referenced, however the *Road Drainage Manual (2nd edition)* takes precedence.

The *Austrroads Guide to Road Design* sections are:

- *Guide to Road Design Part 5: Drainage – General and Hydrology Considerations*
- *Guide to Road Design Part 5A: Drainage – Road Surface, Network, Basins and Subsurface*
- *Guide to Road Design Part 5B: Drainage – Open Channels, Culverts, and Floodways*

## **Part 6: Roadside Design, Safety and Barriers**

See [Supplement to Austroads Guide to Road Design – Part 6: Roadside Design, Safety and Barriers](#)



## **Part 6A: Pedestrian and Cyclist Paths**

Further work is required to complete the transition of content from the *Road Planning and Design Manual (1st edition)*, to align with Austroads guides and reflect Transport and Main Roads practice in Queensland. Until then the following guidance applies.

The *Austroads Guide to Road Design - Part 6A* should be used for information on pedestrian and cyclists paths.

Also refer to the table of exceptions published under 'Cycling Infrastructure Policy' on the Transport and Main Roads website at: [www.tmr.qld.gov.au/Travel-and-transport/Cycling/Cyclists](http://www.tmr.qld.gov.au/Travel-and-transport/Cycling/Cyclists).

## Part 6B: Roadside Environment

The Department of Transport and Main Roads has not fully reviewed the *Austrroads Guide to Road Design - Part 6B: Roadside Environment*, therefore it may only be used for information.

Projects in Queensland must refer to the relevant departmental technical publications and standards when considering any of the following elements in road design:

### Environmental

- Stormwater Run-off
- Fauna Management
- Noise Control

### Roadside Amenity

- Urban and Regional design
- Visual Amenity
- Landscaping
- Rest Facilities

### Roadside Infrastructure

- Road Furniture
  - Signs, Markings and Delineation
  - Poles
  - Traffic Signal Pedestals
  - Supports for Road Signs
  - Fences
- Road Lighting
- Emergency Help Telephones
- Off-street Parking
- Utilities

These technical documents are available from the Transport and Main Roads website:

[www.tmr.qld.gov.au](http://www.tmr.qld.gov.au)

## **Part 7: Geotechnical Investigation and Design**

The *Austrroads Guide to Road Design - Part 7* is accepted.

Please refer to the Austrroads guide for information for those engaged in road design of the importance of geotechnical investigations and how road design outcomes and other design activities are influenced by site conditions, associated ground response, geological hazards and locally available material.

## Part 8: Process and Documentation

Further work is required to complete the transition of content from the *Road Planning and Design Manual (1st edition)*, to align with Austroads guides and reflect Transport and Main Roads practice in Queensland.

Until this transition is completed, refer to the *Preconstruction Processes Manual* for criteria on processes and documentation requirements. The *Austroads Guide to Road Design - Part 8* may be read in conjunction with the *Preconstruction Processes Manual* for additional information.

Design Development Reports are integral to the design and development process. The templates for completing these reports are:

- *Design Development Report (Small Projects)*
- *Design Development Report (Large Projects)*

The above templates can be accessed from the 'References' section of the *Road Planning and Design Manual (2nd edition)* web page on the department's website: [www.tmr.qld.gov.au](http://www.tmr.qld.gov.au)

Designers should refer to the following content about safety in design (incorporated from *TN PD18 - Safety in Design*) for the department's direction on compliance with the *Workplace Health and Safety Act 2011*.

### 1 Safety in design

#### 1.1 Introduction

In 2008, Ministers from the Commonwealth and each state and territory government agreed to a set of principles and processes for cooperation to develop and implement common occupational health and safety legislation. This process, referred to as harmonisation, included the development of a model Act, supported by model Regulations, model Codes of Practice, and a National Compliance and Enforcement Policy.

The *Work Health and Safety Act 2011* and *Work Health and Safety Regulation 2011* commenced in Queensland on 1 January 2012. The legislation reflects the model in most respects but does contain a number of differences, including:

- Transitional arrangements, to allow for gradual change from the previous legislation
- Provisions that have been delayed to allow for further analysis and consultation
- Queensland specific variations.

The majority of states and territories have adopted the model legislation with local variations. However, Western Australia and Victoria have indicated they will conduct further analysis and consultation before implementing the legislation.

Safe Work Australia is the national policy body responsible for the development and evaluation of the model Work Health and Safety laws, in consultation with the states and territories.

The Commonwealth, states and territories are responsible for regulating and enforcing work health and safety laws in their jurisdictions.

Below is a table showing Queensland's progress in implementing the new laws. The links provided will take you to these documents for Queensland where the WHS Act and the WHS Regulations have already been enacted.

**Table 1: WHS Act and Regulations Links**

Jurisdiction	Introduced to parliament	Passed	Date of Implementation
Queensland			
<a href="#">Work Health and Safety Act 2011</a>	10 May 2011	26 May 2011	1 January 2012
<a href="#">Work Health and Safety Regulation 2011</a>	Approved on 24 November 2011	29 November 2011	1 January 2012

### Objective of the Work Health and Safety Act

The main object of this Act is to provide for a balanced and nationally consistent framework to secure the health and safety of workers and workplaces.

Subsection 2 goes on to say “*in furthering subsection (1)(a), regard must be had to the principle that workers and other persons should be given the highest level of protection against harm to their health, safety and welfare from hazards and risks arising from work or from particular types of substances or plant as is reasonably practicable*”.

#### 1.2 Codes of practice

Codes of Practice are practical guides to achieving the standards of health, safety and welfare required under the Work Health and Safety (WHS) Act and the Work Health and Safety (WHS) Regulations.

A code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in the WHS Act, in relation to the subject matter of the code. Like regulations, codes of practice deal with particular issues and do not cover all hazards or risks which may arise. The health and safety duties require duty holders to consider all risks associated with work, not only those for which regulations and codes of practice exist.

Codes of practice are admissible in court proceedings under the WHS Act and Regulations. Courts may regard a code of practice as evidence of what is known about a hazard, risk or control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code relates.

Compliance with the Act and Regulations may be achieved by following another method, such as a technical or an industry standard, if it provides an equivalent or higher standard of work health and safety than the code.

The model Codes of Practice have been developed by Safe Work Australia and informed by public comment. A model Code of Practice must be approved by the local state or territory government before it applies in that jurisdiction.

Safe Work Australia has developed the model Code of Practice *Safe Design of Structures*. Queensland is yet to approve this code. However, in the absence of a local code of practice it is still a

useful document for understanding the duties in the legislation that apply to designers and the methods that can be used to comply. The code can be viewed by following the link:

<http://www.safeworkaustralia.gov.au/sites/swa/about/publications/pages/safe-design-of-structures>

The *Safe Design of Structures* model Code of Practice (July 2012) is the most relevant code that applies to the design of road transport infrastructure under the WHS Act, and has been endorsed by Safe Work Australia's members. For advice on implementation of model Codes of Practice in Queensland please contact [Workplace Health and Safety Queensland](#).

Advice received from Safe Work Australia states, "a public road is only considered a workplace while workers are constructing it or otherwise carrying out work on the road, such as when they are repairing, upgrading or maintaining the road."

### **1.3 Key concepts**

#### **Person conducting a business or undertaking (PCBU)**

A business or an undertaking that is either conducted alone or with others, whether or not for profit or gain. A PCBU can be a sole trader (for example a self-employed person), a partnership, company, unincorporated association or government department or public authority (including a municipal council). An elected member of a municipal council acting in that capacity is not a PCBU.

The Department of Transport and Main Roads is the PCBU for any work conducted by a worker (permanent or contracted).

#### **Reasonably practicable**

Means that which is, or was at a particular time, reasonably able to be done to ensure health and safety, taking into account and weighing up all relevant matters including:

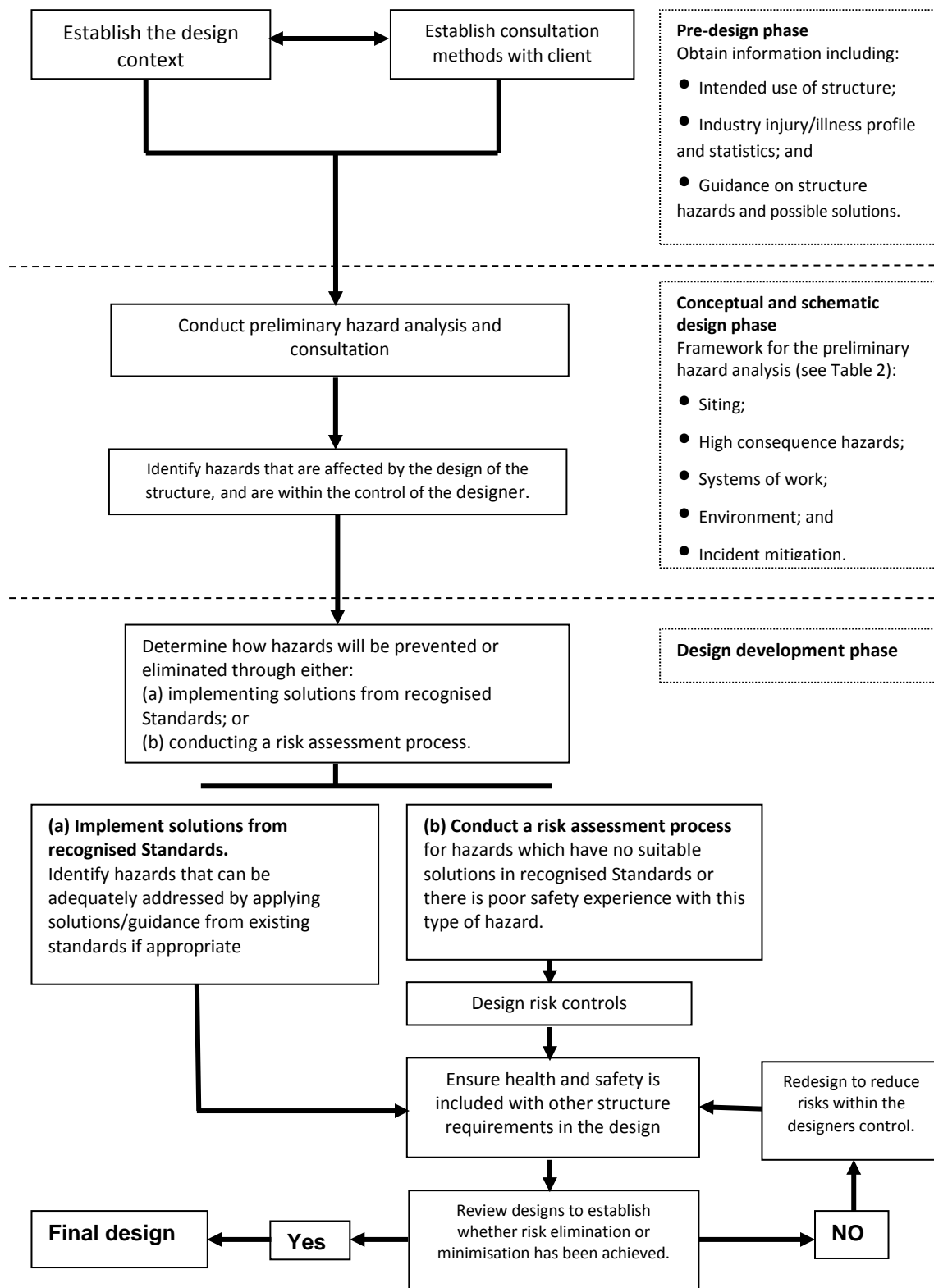
- the likelihood of the hazard or the risk concerned occurring
- the degree of harm that might result from the hazard or the risk
- what the person concerned knows, or ought reasonably to know, about the hazard or risk, and ways of eliminating or minimising the risk
- the availability and suitability of ways to eliminate or minimise the risk
- after assessing the extent of the risk and the available ways of eliminating or minimising the risk, the cost associated with available ways of eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk.

For the most part, the WHS Act requires PCBUs to eliminate risk or, where that is not reasonably practicable, minimise the risk as far as is reasonably practicable. This means that where it is reasonably practicable to use a higher order control measure, the higher order control must be implemented.

### **1.4 What is safe design?**

Safe design means the integration of control measures early in the design process to eliminate or, if this is not reasonably practicable, minimise risks to health and safety throughout the life of the structure being designed. Refer to Figure 1

Figure 1: A systematic approach to integrating design and risk management



Source: Safe Work Australia, *Safe Design of Structures Code of Practice*.

The safe design of a structure will always be part of a wider set of design objectives, including practicability, aesthetics, cost and functionality. These sometimes competing objectives need to be balanced in a manner that does not compromise the health and safety of those who work on or use the structure over its life.

Safe design begins at the concept development phase of a structure when making decisions about:

- the design and its intended purpose
- materials to be used
- possible methods of construction, maintenance, operation, demolition or dismantling and disposal
- what legislation, codes of practice and standards need to be considered and complied with.

A person conducting a business or undertaking that designs a structure that will be used, or could reasonably be expected to be used, as a workplace must ensure, so far as is reasonably practicable, that the structure is without risks to health and safety. This duty includes carrying out testing and analysis and providing specific information about the structure.

A designer is a person conducting a business or undertaking whose profession, trade or business involves them in:

- preparing sketches, plans or drawings for a structure, including variations to a plan or changes to a structure
- making decisions for incorporation into a design that may affect the health or safety of persons who construct, use or carry out other activities in relation to the structure.

Ultimately, it is the determination of the courts as to whether someone is a designer or not. In the event of an incident that undergoes prosecution it will be determined based on the information that is available and relevant to that particular case. However, the model Code of Practice for the Safety Design of Structures lists the following professions, roles and functions as designers. It is reasonable to assume that they may be considered designers under the WHS Act in Queensland also:

- architects, building designers, engineers, building surveyors, interior designers, landscape architects, town planners and all other design practitioners contributing to, or having overall responsibility for, any part of the design (for example, drainage engineers designing the drain for a new development)
- building service designers, engineering firms or others designing services that are part of the structure such as ventilation, electrical systems and permanent fire extinguisher installations
- contractors carrying out design work as part of their contribution to a project (for example, an engineering contractor providing design, procurement and construction management services)
- temporary works engineers, including those designing formwork, falsework, scaffolding and sheet piling
- persons who specify how structural alteration, demolition or dismantling work is to be carried out.

A person conducting a business or undertaking who alters or modifies a design without consulting the original or subsequent designer will assume the duties of a designer. Any changes to the design of a



structure may affect the health and safety of those who work on or use the structure and must be considered by the person altering or modifying a design.

### **1.5 Requirements for compliance with legislation**

With respect to the design of structures, including roads and associated infrastructure, the duties of designers under the WHS Act can be summarised as follows:

- 1) to ensure the structure that is to be used as, or at, a workplace is designed to be without risks to the health and safety of any person that constructs or dismantles/demolishes the structure
- 2) to ensure the structure is designed to be without risks to the health and safety of any person, who, at a workplace, uses the structure for the purpose for which it was designed
- 3) to carry out, or arrange the carrying out of, any calculations, analysis, testing or examination necessary to ensure items 1) and 2)
- 4) to give adequate information to any person that is provided with the design for the purpose of giving effect to it (e.g. building the structure, managing the building of the structure), including:
  - the purpose for which the structure was designed
  - any information generated by item 3)
  - any conditions necessary to ensure the structure is without risks to health and safety when used for the purpose for which it was designed, or constructing it, or dismantling/demolishing it
- 5) to provide current information on any of the matters listed in items 1) to 4) to any person that requests it, so far as is reasonably practicable
- 6) for any designs of structures that have unusual or atypical features, to give the person that commissioned the design (the design client) a written report (the Safety in Design Report) specifying the unusual or atypical hazards relating to the design that create a risk to the health and safety of persons that will carry out construction work on the structure.

A road will be considered to be a workplace when, for example:

- it is being constructed
- maintenance is performed on or along it
- it is being demolished
- work is done on it (for example, school crossing supervisor, road inspectors).

### **1.6 SiD Report**

The content of a Safety in Design Report, where required:

- Must document risks to the health and safety of construction and maintenance personnel both during the initial construction of the project and while undertaking construction/maintenance/demolition activities at any future stage.
- May document risks to individuals travelling through the construction site, including vehicular and pedestrian traffic, if the risks are considered to be of significance and not specifically covered in standard reference material outlined below. Suitable risk mitigation strategies for this scenario can be achieved by applying the appropriate design criteria in the Transport and

Main Roads *Road Planning and Design Manual*, the *Manual of Uniform Traffic Control Devices*, Austroads Guides, other industry standards, and Road Safety Audits.

- Would not normally include risks to drivers travelling through the project after construction has been completed. These risks should be mitigated by applying the appropriate design criteria in the Transport and Main Roads *Road Planning and Design Manual*, Austroads Guides, other industry standards relating to road design, and Road Safety Audits.

The Safety in Design Report will be passed from phase to phase along with other design development documentation to demonstrate a continuous flow of risk identification and elimination/mitigation.

### **1.7 Transport and Main Roads Design Phases**

The following outlines where the Safety in Design Report should fit in the department's planning and design process:

- **TMR Phase 1 - Concept Phase - Business Case** (Deliverables: Design Development Report, Road Safety Audit and a Safety in Design Report)
- **TMR Phase 2 - Development Phase - Preliminary Design** (Deliverables: Updated Design Development Report, Road Safety Audit Preliminary Design, Risk Management Record, and a Safety in Design Report)
- **TMR Phase 3 - Development Phase - Detailed Design** (Deliverables: Updated Design Development Report, Road Safety Audit Detailed Design, Risk Management Record, and a Safety in Design Report)

Transport and Main Roads will follow a similar path to that outlined in the *Safe Design of Structures Code of Practice*.

**Step 1:** Identify stakeholders who will need to be consulted with during the design development starting at the Concept development stage and undertake some initial planning and design activities based on information obtained during the options analysis stage.

**Step 2:** Document perceived risks to personnel during the construction, maintenance or demolition phases of the project.

**Step 3:** Undertake consultation with relevant stakeholders to determine whether the risk can be eliminated from the design or minimised as far as is reasonably practicable. Reference to recognised standards should be made in order to determine how the hazard may be prevented or eliminated. People with specific skills and expertise from the construction, maintenance, and health and safety areas will need to be included in the design team or consulted during the design process to fill any knowledge gaps.

**Step 4:** Document all remaining risks that will need controls to be implemented in the relevant phase of the project lifecycle. Where temporary works and traffic control arrangements are proposed during construction, risk assessment of these measures also needs to be done. Documented risks and risk assessments should accompany the design at all times.

**Step 5:** For designs with unusual or atypical features, review the design and compile a Safety in Design Report that demonstrates how each of the steps above have been undertaken. Compilation of the resultant Risk Assessment matrix to be passed to the next phase of the design development, construction, or maintenance activities should be included as part of the report.

The Report should highlight any unusual or atypical features that pose a risk to health and safety of workers during the construction phase.

**1.8 Additional references**

*Legislative guide—designer written report for a structure (LG-DR)* is available from the Workplace Health and Safety Queensland website:

<http://www.deir.qld.gov.au/workplace/law/whslaws/resources/index.htm>

