Guide to Temporary Traffic Management Part 3

Static Worksites

Austroads

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Part 3: Static Worksites

Austroads

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Guide to Temporary Traffic Management Part 3: Static Worksites

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Abstract

Austroads' Guide to Temporary Traffic Management (AGTTM) details contemporary temporary traffic management practice for application in Australia and New Zealand. It provides guidance for the planning, design and implementation of safe, economical and efficient temporary traffic management designs. This Guide recognises the level of variability of the road environments for which guidance is provided. The guidance provided in AGTTM is intended to encourage a consistent level of planning that supports the streamlined safe progress of work. It applies to all works on roads and near roads, in addition to off road development and other activities that interact with and impact on the road environment.

AGTTM has been developed based on best practice temporary traffic management practice in Australia and New Zealand, to assist road authorities to meet their existing legislative responsibilities for workplace and public safety.

Part 3 has been specifically prepared to assist with the preparation of traffic guidance schemes (TGSs), in accordance with Austroads best practice. It provides general information about the context and components of designing temporary traffic guidance schemes at static worksites.

Keywords

Temporary traffic management, worksite traffic control, risk assessment, road safety

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Edition 1.1 contains additional information regarding how a reduced speed limit should be implemented, the use of Variable Message Signs, Queue Ahead signs and correction to errors in some diagrams and figures.

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Austroads

About Austroads

Austroads is the peak organisation of Australasian road transport and traffic agencies.

Austroads' purpose is to support our member organisations to deliver an improved Australasian road transport network. To succeed in this task, we undertake leading-edge road and transport research which underpins our input to policy development and published guidance on the design, construction and management of the road network and its associated infrastructure.

Austroads provides a collective approach that delivers value for money, encourages shared knowledge and drives consistency for road users.

Austroads is governed by a Board consisting of senior executive representatives from each of its eleven member organisations:

- Transport for NSW
- Department of Transport Victoria
- Queensland Department of Transport and Main Roads
- Main Roads Western Australia
- Department for Infrastructure and Transport South Australia
- Department of State Growth Tasmania
- Department of Infrastructure, Planning and Logistics Northern Territory
- Transport Canberra and City Services Directorate, Australian Capital Territory
- The Department of Infrastructure, Transport, Cities and Regional Development
- Australian Local Government Association
- New Zealand Transport Agency.

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1. Introduction

1.1 Purpose

Managing the risks associated with providing an optimal level of safety for persons working in or near traffic and the impact of road work on road users, road congestion and the general community, is a significant issue for road agencies and industry. Road agencies and industry have a legislative requirement as an employer of construction, operational and maintenance services to provide a safe work environment and to manage the risks of working in or near traffic through current jurisdictional Work Health and Safety (WHS) requirements, regulation, training and roadwork planning.

The Austroads Guide to Temporary Traffic Management (AGTTM) details the contemporary temporary traffic management practice of member organisations. In doing so, it provides guidance to designers in the production of safe, economical and efficient temporary traffic management designs. This Guide recognises the level of variability of the road environments for which guidance is provided. The guidance provided in AGTTM is intended to encourage the consistent planning, design and implementation of temporary traffic management across Australia and New Zealand while also supporting the streamlined safe progress of work. It applies to all works on roads and near roads, in addition to off road development and other activities that interact with and impact on the road environment.

The purpose of the AGTTM is to provide guidance and supporting material that:

- supports the ability of road agencies and industry to meet their WHS requirements and lead to improved safety outcomes at road worksites
- improves the standard of temporary traffic management in Australia and New Zealand through consistency of application which assists road users to recognise and understand temporary traffic management, thereby improving their behaviour and safety
- aims to reduce the rate of incidents occurring at worksites
- improves the ability of road authorities and industry to manage the increasing frequency and variety of activities that are being undertaken on and near the road
- allows continuous industry review to maintain best practice.

This purpose is achieved through:

- providing direction for all matters relating to the planning, design and implementation of temporary traffic management
- facilitating improved adaptation to changes in technology and practices through being reactive to changes and being able to readily include new innovations
- providing guidance focused on the users of this Guide
- providing road agencies and industry with uniform practices whilst carrying out works on or near roads.

The benefits associated with uniform guidance broadly accepted by jurisdictions and industry include:

- guidance and training that appropriately develop designers with the skills necessary to develop and deliver safe traffic management at road worksites
- reduced impost on industry working across jurisdictional borders
- improved harmonisation of road worksites across jurisdictions providing improved consistency for road users, including vulnerable road users such as pedestrians and cyclists. This is targeted at improving road user behaviour, safety of road worksites and reducing impact on road congestion and the general community.

1.2 Structure of AGTTM

The structure and content of the Austroads Guide to Temporary Traffic Management is discussed in AGTTM Part 1: Introduction. Within the AGTTM, the terminology that applies is detailed in Table 1.1.

Table 1.1: Guidance terminology

Guide	The description for the complete Austroads Guide for Temporary Traffic Management (AGTTM) including all 10 Parts.
Part	The description for the individual documents within the Guide. This document is Part 3 of the Austroads Guide to Temporary Traffic Management.
Section	The description for a numbered section within each Part of the Guide. This is Table 1.1 placed within Section 1.2 of Part 3 of the Austroads Guide to Temporary Traffic Management.

Within this Guide, reference may be made to other parts of the Austroads range of publications such as the *Guide to Road Design* and the *Guide to Traffic Management.*

In the context of the other guides within the Austroads range of publications, this Guide is restricted to matters relating to temporary traffic management practice and refers only briefly to issues more appropriately addressed in other Austroads Guides. It is recognised it is difficult, if not impossible, to discuss many aspects of temporary traffic management practice without reference to traffic management, road design and/or safety issues. The view is taken that within the AGTTM, any such advice should be brief and be supported by references to other Guides for the appropriate guidance as required.

The scope of the AGTTM is broad, addressing requirements and recommendations for protecting road workers and all road users, including vulnerable road users, from hazards, road traffic and other impacts of road works across a range of situations that may include:

- urban and rural environments
- motorways, major arterial roads, local roads, roads in built-up areas, roads in open road areas and unsealed roads
- all variations of road use by cars, heavy vehicles, public transport, motorcycles, cyclists and pedestrians
- day and night works
- changing road and weather conditions.

The structure of the AGTTM is described in Figure 1 and in Table 1.2.

Figure 1.1: Structure of the Austroads Guide to Temporary Traffic Management

<table>
<tr><td>Overview</td><td colspan="6">Part 1: Introduction</td></tr>
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Table 1.2: Parts of the Austroads Guide to Temporary Traffic Management

Part	Title	Content
Part 1	Introduction	• Introduction to the discipline of temporary traffic management practices • Breadth of the subject and the relationship between the Parts of the Guide • Legislative relationships • Links to related jurisdictional documentation • Definitions
Part 2	Traffic Management Planning	• Broad strategies and objectives to provide effective temporary traffic management to ensure the safety for all road users is maintained • Guidance on the safety of workers and other road users • Examples and key considerations for planning of temporary traffic management at road worksites • Process for planning and documenting temporary traffic management
Part 3	**Static Worksites**	• **Guidance on the design of temporary traffic guidance schemes at static worksites** • **Process to decide what static worksite set up is appropriate to implement (including devices used)**
Part 4	Mobile Works	• Guidance on the design of temporary traffic guidance schemes at mobile works • Process to decide what mobile works set up is appropriate to implement (including devices used)
Part 5	Short Term Low Impact Worksites	• Guidance on the design of temporary traffic guidance schemes at short term low impact worksites • Process to decide what short term low impact worksite set up is appropriate to implement (including devices used)
Part 6	Field Staff – Implementation and Operation	• On-site risk assessment • Installation and removal of temporary traffic management schemes • Operation and monitoring of temporary traffic management schemes • Record keeping
Part 7	Traffic Controllers	• Training competencies • Instructions on practices • Control devices that can be used
Part 8	Processes and Procedures	• Road network classification • Powers, roles and responsibilities • Training competencies • Forms and procedures • Model contract specification
Part 9	Sample Layouts	• Example layouts of static worksite conditions • Example layouts of mobile works conditions • Example layouts of short term, low impact conditions • Example layouts for staging plans • Worked example for a multi-stage project
Part 10	Supporting Guidance	• Risk management processes • Review, inspection and road safety audit of worksites • Events • Emergency works

1.3 Scope of Part 3

AGTTM Part 3 provides guidance to designers on TTM at road worksites. TTM design is typically prepared in the form of a traffic guidance scheme (TGS) which is subsequently applied by field staff when installing these schemes at road worksites.

This part of AGTTM covers roadworks which are greater in scope and duration than can be handled by short term, low impact provisions or mobile works. Static worksites include those that may be left unattended.

AGTTM Part 3: Static Worksites together with Part 4: Mobile Works and Part 5: Short Term Low Impact Works provides comprehensive guidance for the design of TGSs at all worksites.

Aspects covered in this Part for the design of TTM include:

- general design considerations for static worksites
- selection of appropriate static work practices
- the design process to be followed for the design of static worksites
- detailed design guidance for each step in the design of static worksites
- supporting information to be included with the TGS.

The central purpose of TTM is the selection and application of practices that manage public and occupational safety and network performance risks associated with work activities undertaken in a traffic environment. Risk management and the elements of the risk management process form the basis of this document.

1.4 Application of Part 3 to New Zealand

Readers in New Zealand should note the following in application of Part 3 of this Guide:

- Signs depicted in a number of the figures reflect Australian signage. Readers in New Zealand should refer to the NZ CoPTTM for the appropriate signs to be applied.

1.5 Definitions

Refer to AGTTM Part 1 for a full list of definitions which apply to this Part.

2. Design Process

2.1 General

A Traffic Management Plan (TMP) outlines how works on roads are integrated into the operation of the road network, identifies and considers all foreseeable risks and assesses the impact on all road users. Detailed guidance on TMP processes are outlined in AGTTM Part 2.

It is important that the TMP is completed before further considerations and design of TTM outlined in this Part of the Guide are implemented. The design involves the preparation of a Traffic Guidance Scheme (TGS), in some cases more than one, detailing traffic control signs, devices and measures to be applied at worksites to warn road users and guide them around, through or past a work area or temporary hazard. The work area is defined as an area where workers (including workers on foot) may be located.

For static worksites, which often involve complex traffic arrangements, a TMP and TGS are required. Numerous and specific TGSs may be required for each separate element of the works. Preparation of a detailed TGS and proper implementation of measures identified in the TMP is essential to ensure the safety of all road workers and road users, including vulnerable road users. It also assures the smooth operation of the road network as well as the worksite.

This guidance is for those responsible for designing a TGS and the successful application of this document is dependent on the provision of appropriate training to all those involved in the design and operation of traffic management arrangements at road works (see AGTTM Part 8).

Although the optimal option for design parameters should be used as often as possible, it is recognised that this guidance cannot cover all situations. It is the designer's responsibility to adapt or develop the traffic management required to suit site conditions and the scope of works.

Before proceeding with the design steps required for a TGS, the following essential considerations must be undertaken:

- Determine whether a static worksite is an appropriate traffic management measure.
  For example, if the works are to protect major construction or a deep excavation that will take hours or days, then a static worksite with barriers may be appropriate. However, if the works are minor in nature (e.g. vegetation trimming) or can be performed quickly along multiple sites (within 20 minutes) then a short term, low impact (see AGTTM Part 5) or mobile (see AGTTM Part 4) worksite may be more appropriate.
- Risk assessment (see Section 2.2).
- Determine the method of traffic control. Is it around (Section 3), through (Section 4) or past (Section 5) the worksite?
- Determine road work impacts and methods of traffic management.
  For example, road closures and property access, complexity of intersections, public transport access or other facilities.

2.2 Risk Assessment

Risk assessment involves the identification and analysis of all safety risks likely to arise during works on or near the road including design, set up, operation, change and final dismantling of TTM devices. The identification of each risk must be followed by defining the appropriate measures to mitigate those risks.

Risk assessment is appropriate at all levels of planning and operation and must be undertaken when:

- preparing generic plans and safe work method statements for the conduct of short term, low impact or mobile works
- preparing a TGS for more extensive or complex works (static worksites) where site specific risks are of importance
- justification of design exceptions and departures from published standards and this AGTTM.

In each case the process starts by identifying all the hazards likely to arise, evaluating them in terms of likelihood of occurrence and their adverse consequences using experience, historical data, consulting with other designers or other means. The proposed TGS must then be checked in detail to ensure that adequate means of controlling or reducing those risks are in place. It is important to note that a Design Exceptions Report must be approved by the relevant Road Infrastructure Manager (RIM) and road authority if design exceptions are made or published standards or the AGTTM are not adhered to.

Note that safety is influenced by the interaction of various factors and strictly following standards or this AGTTM may not always result in the safest possible design. A designer must consider how the road corridor is being used by all road users to identify an appropriate strategy for managing risks to all road users, giving special attention to the needs of vulnerable road users, motorcyclists and over-dimensional vehicles.

2.2.1 Risk considerations

The best practice to achieving optimal safety levels is achieved by constant referencing to the basics and working through each category of risk. When identifying risks, open questions such as how, why, when and where should be asked to find the source of the problem and how to mitigate it. Example factors to be considered and questions to be asked when considering risks involved in the design of TTM for static worksites are described in Table 2.1. This is not an exhaustive list and often site-specific risk considerations may be applicable.

Table 2.1: Risk considerations

Risk Category	Considerations
Road worker safety	There is an obligation on both the organisation and road workers, including supervisory personnel, to maintain a safe worksite when carrying out works on and near roads. This involves the prevention of injury to road workers due to hazards within the worksite or from oncoming or passing traffic. Considerations relating to worksite safety should include: • the use of a road safety barrier system • maintenance of an acceptable clearance from traffic • removal of traffic controllers from the road where possible and replacing with an approved portable traffic control device (PTCD) • traffic control (e.g. temporary speed limits) • appropriate training for all road workers and compliance of appropriate work methods and safety requirements. Risks for road workers include: • complacency as a result of frequency of activities • level of training provided • maintaining appropriate separation of tasks, including to lookout persons, such as being requested to undertake additional tasks • higher risk exposure when undertaking short term low impact works • time constraints associated with the short-term nature of works • night work considerations • work pressures. All road workers must: • sign the safe work method statement prepared for that site and contribute to the risk assessment • immediately report any unsafe conditions • take reasonable care for his or her own personal safety and the safety of all road users • consider any requirements specific to night-time works • take reasonable care that his or her acts or omissions to ensure that they do not adversely affect the health and safety of others • comply with any reasonable instruction that is given in relation to health and safety • cooperate with any reasonable policy or procedure relating to health and safety that they have been notified of. Personal protective equipment (PPE) is essential for the safety of road workers and must be put on before entering the worksite. Wearing a high visibility garment is a critical element of personal safety and must always be done up with sleeves down and in acceptable condition. Other required PPE may include: • head protection • eye protection • hearing protection • sun protection • reinforced toe cap boots.
Road users	Road users (including vulnerable road users) need to perceive and process information, make decisions and act and monitor within time constraints. Safe driving and riding occur when road users are operating well below a stressful processing and decision-making rate. These are critical in the development and maintenance of a safe road environment. Risks associated with road users include: • unsafe reactions as a result of surprise • response to stationary vehicles or plant parked near the road • restricted sight lines • hazards created by work equipment or debris.

Risk Category	Considerations
Road users (cont)	Safe traffic management should: • warn all road users of any hazard or changed conditions • guide and inform road users • control road users' speed and passage around, through or past the worksite • consider driver behaviour and make allowance for human error and errant vehicles. Questions to ask include: • Will the impact on the transport network be disruptive to road users? • Is the speed limit safe for all road users during works? • Where are the hazards that impact any road users? • Is there adequate visibility or are there obstructions to vision? • Are requirements needed for special vehicles (e.g. over-dimensional vehicles, buses, emergency services)? • Could the intention of traffic control devices be misunderstood? Will it cause confusion? • Do proposed traffic control devices provide enough information?
Vulnerable road users	Consider pedestrians, including school children and road users with impaired vision, mobility or cognitive limitations. Consider cyclists, of varying levels of confidence and ability, using either the path network, bike lane, the road shoulder or mixed traffic lane. Note that the main cycling movements may occur during the early mornings, before peak hours. Works that impact the road, road shoulder or verge may affect vulnerable road users. To manage risk to these users, practitioners should ensure that: • pedestrians and cyclists are not led into direct conflict with the works or traffic moving around, through or past the worksite • pedestrians and cyclists should only be directed into live lanes if it is safe for them to be there • pedestrians and cyclists are safely directed onto appropriately sized, safe and impediment free temporary paths • warning signage does not increase the risk to cyclists using the road corridor • road shoulders that may be used by cyclists are kept free of hazards including signage, or an appropriate tapered treatment is used to close off lanes and direct cyclists to alternative facilities • appropriate sight distances are maintained between pathways and intersections, driveways and site access points. See also *Road users* (above)
Site conditions	Consideration relating to the impact of the road and roadside environment should include: • safety implications of travel restrictions or closures • road category and traffic volumes relative to the time of day and day of the week (see *Traffic volume* (below)) • allowance for unexpected changes to traffic volumes • traffic profile (e.g. the proportion of over-dimensional vehicles in the traffic stream) • traffic speed • sight distances (see Section 2.5.4) • road features (e.g. sealed, condition of seal, unsealed, available lanes, shoulder widths, intersections, railway crossings, bridges etc.) • access control - at each point on the road system where vehicles have access to adjacent property, there is the potential for conflict and crashes • lighting • where possible, source current site information including thorough on-site inspection, photos or videos • drainage management.

Risk Category	Considerations
Parked vehicles	Vehicles parked on or adjacent to the road, including the work vehicle, affect safety in several ways: • as physical obstructions that are can be collided with • as obstructions that cause sudden braking and nose-to-tail crashes • as obstructions that deflect vehicles into adjacent vehicle paths • as hazards to passing vehicles (including bicycles) from opening doors • as obstructions that hide pedestrians • as obstructions that block visibility at intersections and access points • vehicles parked on the road shoulder are likely to force on road cyclists into traffic lanes.
Adverse weather conditions	Adverse weather conditions should be identified in the TGS and include appropriate contingency plans. For example, when adverse weather conditions affect visibility of traffic control devices or the worksite it may be necessary to stop work and clear the worksite of all road workers in the interest of safety. In some cases, it may also be necessary to clear the road of all obstructions caused by the works if this can be done safely. A decision on the need to clear the road will be based on the consideration of all prevailing circumstances, which may include: • type of adverse weather condition (snow, frost, fog, rain, wind etc.) • the complexity of worksite • traffic volumes • road surface • time of day • appropriate lighting • sun glare or areas of shade.
Unattended worksites	Unattended worksites contribute additional risks and further considerations should be given to the following: • the undesirable movement of traffic control devices • damage to traffic control devices • injury due to entanglement, falling, crushing, trapping, abrasion or tearing • other incidents which may occur whilst the worksite is unsupervised.

2.2.2 Hierarchy of control - eliminate, separate or control

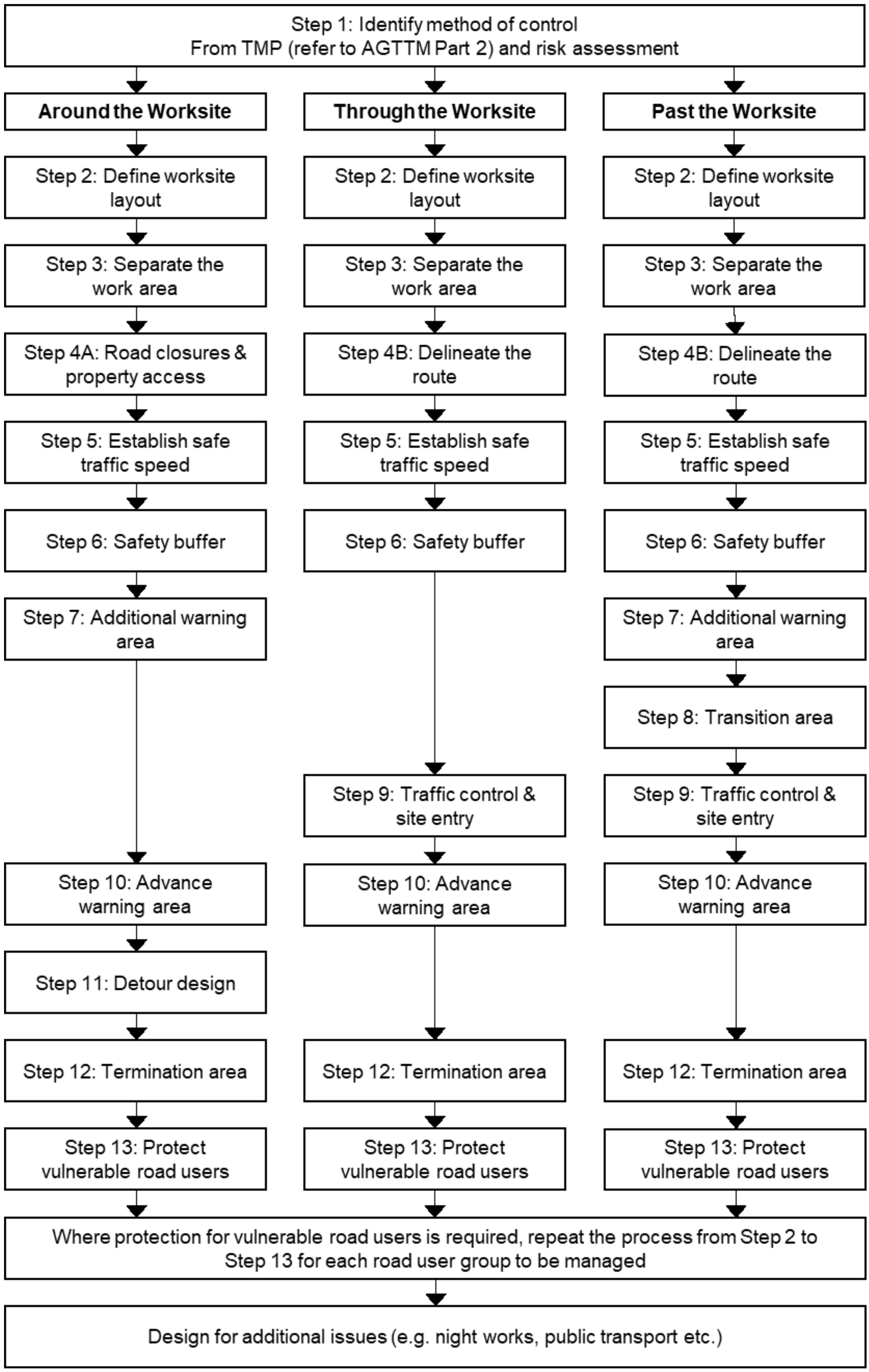
When designing a TGS and conducting works there is a hierarchy of control which must be used to assess whether the highest practicable level of protection and safety is being applied. The hierarchy of control has the following elements and corresponding worksite types from most safe, to least safe:

- Around the worksite – eliminates the hazard from the immediate worksite by restricting road access and relocating road users' movement via a detour or sidetrack (see Section 3).
- Through the worksite – separates the hazard by stopping all road user's movement for short periods when workers need to occupy the roadway (see Section 4).
- Past the worksite – separates the hazard by safely moving road users by using traffic management methods and devices (see Section 5).
- Mobile worksite – hazard control (see AGTTM Part 4).
- Short term low impact worksite – hazard control (see AGTTM Part 5).
- Field staff – hazard identification and control (see AGTTM Part 6)

Consider the relevant type of worksite when addressing risks and working through the design process of TTM methods. Any individual project may use more than one type of control method for various work types.

2.3 Design Steps – Around, Through, Past

Figure 2.1: Design steps – around, through, past



2.4 Design Balance

The optimum static worksite design involves developing a TGS that finds the right balance for road users, including vulnerable road users, road workers, the traffic management team, contractor, road infrastructure manager and end client.

The safety and protection of road workers and road users is the primary concern. This can be achieved through adequate risk assessment (see Section 2.2) and traffic control of road users including motor vehicles, heavy or over-dimensional vehicles, motorcyclists, pedestrians, cyclists, public transport or any other road user. Providing adequate, well considered traffic control and guidance will enhance the safety of road workers and road users and provide the least amount of inconvenience to traffic flow. This will minimise:

- risk of incidents
- disruption of established traffic movements and patterns
- interference with traffic at peak periods
- interference with public transport services
- the amount of road closed to traffic at any one time.

It is desirable for a worksite to be under the coordination of one contractor at a time, however, traffic management of two different projects might be in close proximity to each other. If this is the case, the person accountable for the traffic management at a site must ensure regular coordination between all relevant persons (e.g. contractors, road workers or road authority) regarding effective and efficient TTM is undertaken and ensure consideration is given during the design phase to the cumulative effects on the transport network from multiple projects.

2.5 Essential Design Principles

2.5.1 Worksite layout

Defining the worksite and its layout is a core element of ensuring the safe and effective implementation of TTM practice. When determining worksite layout consider the following:

- outputs of risk assessment (see Section 2.2)
- the scope of works and what is required (e.g. Is it around, through or past? Will works be unattended?)
- the full extent of the work area within the worksite
- required traffic control devices and equipment
- availability of traffic control devices and equipment. The desired outcome should be to use either the first-choice equipment (i.e. equipment fit for purpose), or acceptable equipment that supports delivering an appropriate balance between competing needs, i.e. the outcome should be unaffected by the equipment available.
- the worksite, including site access points, stockpile areas, plant manoeuvring/parking etc.
- staging of the works
- cumulative risks and holistic situation as individual risks and mitigation strategies may aggregate to an overly complex/risky situation
- any specialist input needed to enable appropriate worksite layout in accordance with this guidance
- any approvals needed to enable appropriate worksite layout in accordance with this guidance.

Design the work area to allow for movement of road workers, equipment, materials and vehicles, including sufficient waiting and storage space for TTM components.

Ensure that the size and position of the work area enables the worksite to be managed effectively for the safety of road workers and road users. The size and position may not be consistent for the whole duration of work depending on changes in project tasks or location. This is to be considered when preparing a TGS with appropriate risk assessment.

2.5.2 Worksite access

Design TTM within and outside the worksite to allow for safe and efficient movement to and from the work area (within the worksite), and entry and exit from the worksite. Consider the various types of work vehicles and workers on foot that will be on site.

When determining methods of entry and exit to the worksite, the following must be considered:

- approach routes
- where possible avoid placing access points on curves
- visibility at the access point (e.g. where fences or signs obstruct sight distance) must ensure that traffic entering or leaving the worksite can see and be seen by other road users, and that vulnerable road users such as children, are visible to traffic entering or leaving the site
- sight distance to access points in or out of the worksite to pedestrian or cyclist paths to prevent conflict
- a clearly defined site entrance for all approaching vehicles that is clearly signed and delineated. Line marking in the form of yellow chevron pavement marking should be considered to delineate a worksite access lane as opposed to a traffic lane for general road users. This requires the approval of the relevant Road Infrastructure Manager as removal of the paint may case road surface damage which requires repair
- the differing speeds of work vehicles and general traffic
- deceleration and acceleration zones either side of an access point for work vehicles entering and exiting the worksite
- the need for general traffic to be stopped for work vehicles entering and exiting
- additional acceleration lane for vehicles exiting the worksite
- the need for multiple access points for entry and exit
- utilising a single direction yellow arrow with ‘ONLY’ stencilled inside of site access points to reduce instances of construction traffic using the entrance point in the wrong direction
- additional special access points for heavy or over-dimensional vehicles (e.g. construction, work vehicles) that have difficulty entering and leaving a normal access point
- the assistance of traffic control (e.g. traffic controller or portable device) at entry and exit points on Category 1 or 2 roads (see Section 2.5.5).

Access points should be located a minimum distance equal to the speed limit measured from the access point to any intersection, on or off-ramp, taper or other obstruction that restricts visibility to the access point. For example, a speed limit of 70 km/h requires the access point to be located a minimum distance of 70 m from the large tree obstructing the visibility of approaching vehicles, to the access point. This guidance is for access points only and not to be used for sight distance to a sign.

Entry and exit of vehicles through an access point should occur in the direction of general traffic flow with their vehicle mounted flashing lamps switched on to warn road users. Vehicles may reverse into a closure where risks are managed, traffic volumes are low enough and there is traffic control in place to ensure the vehicle itself is not a hazard and safety is provided for road workers and road users.

Vehicles leaving a site at a signal-controlled intersection, through a red signal, must be deemed to be entering the public road illegally. As such, an alternative exit point must be located away from the signal-controlled intersection at a minimum distance equal to the speed.

2.5.3 Signs

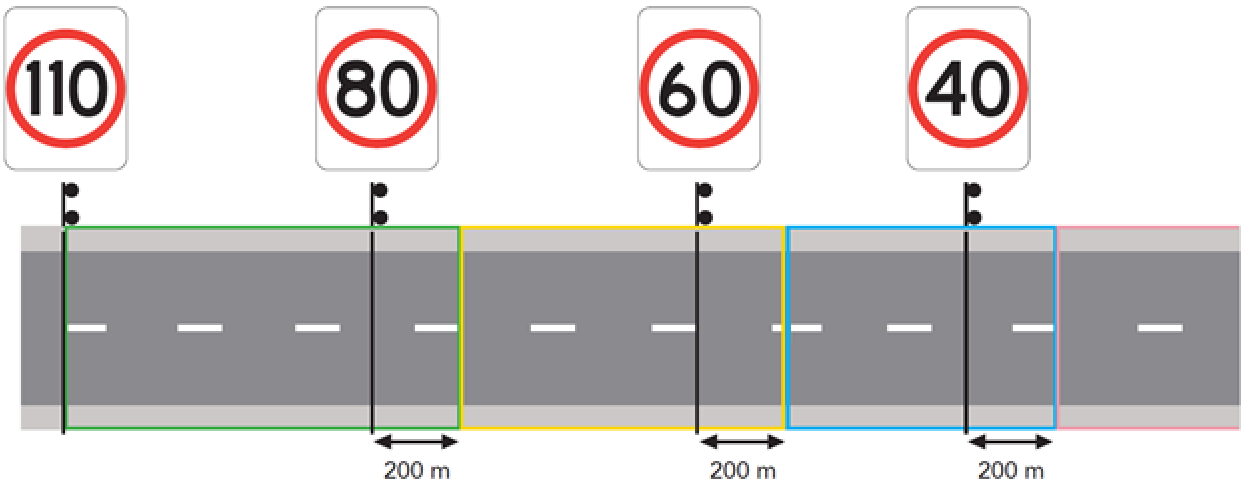
Signs indicate the nature of the hazard or work. For details on choosing an appropriate sign see AS1742.3. Once an appropriate sign is chosen, its location needs to be incorporated into the TGS. There are two steps in sign placement:

1. Locate the sign (see below).
2. Check sight distance (see Section 2.5.4).

Signs must be positioned a distance equal to that shown in Table 2.2 from the worksite or hazard (e.g. taper). Space successive signs (after the primary sign) the same distance as shown in Table 2.2 unless stated otherwise. If there is only a single advance warning sign on the approach, the sign must be positioned at double the spacing shown in Table 2.2 from the worksite or hazard.

When designing spacing of advance warning signs, the speed to use in Table 2.2 must be as per Figure 2.2 rather than the intended travel speed. For example, if signs are positioned in the green zone, even when the speed changes from 110 km/h to 80 km/h, use the distance spacing which corresponds to a speed of 110 km/h in Table 2.2 for the first 200 m past the 80 km/h speed zone signs. If signs are positioned in the yellow zone, even when speed changes from 80 km/h to 60 km/h, use the distance which corresponds to a speed 80 km/h. Use 60 km/h for the blue zone and so on. In summary, always choose the higher speed limit in the first 200 m of the start of the new speed zone to ensure greater distance is provided to more accurately reflect potential travel speeds in these zones.

Figure 2.2: Speed to be used for advance warning sign spacing



Note that sign spacing in Table 2.2 does not apply to the distance between the traffic controller and traffic control sign. Refer to AGTTM Part 7 for traffic controller guidance.

Table 2.2: Sign spacing

Speed (km/h)	Distance (m)
≤55	15
56 - 65	45
≥ 66	Equal to the speed (km/h)

Where site restrictions prevent the placing of required signs (e.g. local topography, median barriers, bridges) the following should be considered:

- moving signs away from the site restriction and installing additional signs
- using smaller signs, subject to the approval of the relevant authority
- using median barrier brackets to support signs, subject to the approval of the relevant authority.

Signs required for works which will be in progress for longer than 14 days may be installed in a more permanent manner on posts sunk into the ground. Check that underground utilities are not located below and making holes is approved by the relevant road authority. Ensure regular site inspection, maintenance and securing practices occur in these circumstances. In these situations, the installation height of all temporary signs mounted in a permanent manner must be based on the principles illustrated in AS 1742.2.

The following must be considered when locating signs:

- Are signs appropriate for their location?
- Are signs located so that drivers' sight distance to the sign is maintained? Where they can be seen and read in adequate time by the intended road user? Sight distance for road users entering from side roads or private driveways must also be considered. The aim is to give road users sufficient warning when approaching a hazard (see Section 2.5.4)
- Are the signs placed at an appropriate height to ensure the drivers vision is maintained?
- Will signs be easily understood?
- Are repeater signs required?
- Have the risks associated with road users striking sign posts been considered?
- Do any additional measures need to be included to make the signage effective? E.g. For temporary speed limits, it is recommended that speed management treatments are included.

Sign placement should not make the sign itself, or its supports, a hazard to road workers, road users or local infrastructure (e.g. public transport). To reduce the risk of signs becoming hazards, the following treatments apply:

- Signs must be securely mounted. For road closures, consider mounting them on barricades or barriers to reduce risk of encroachment. Mounting on vehicles is also acceptable although caution and checks by an appropriately qualified person are recommended if this option is considered.
- Signs should be placed on the side of the road where work is being undertaken, though situations might arise where signs can only be put on the opposite side of the road.
- Signs should be placed on both sides of multilane and high-volume roads to effectively communicate relevant messages to road users. For temporary speed restriction signs, refer to section 5.5.1 for requirements to install on both sides of the road. If sign duplication is not possible (e.g. vegetation, barrier, inadequate width), the designer should document an alternative to ensure all road users are able to see signs. This may involve:
  - placing signs on high temporary frames
  - duplicating signs on one side of the road
  - closing one lane to be used for sign placement
  - use of a variable message sign (VMS).
- Signs and sign support structures should be kept away from the edge of the roadway as outlined in AGTTM Part 6.
- Sign supports on the outside of curves and other vulnerable places should be avoided or the sign support should be protected. Signs used at roadwork sites should be frangible and not require protecting with additional devices such as road safety barriers.

- The Lane Status sign must be used where one or more lanes of a multiway roadway are closed to assist with providing advance warning. These signs must not to be used instead of signage of the closure. They should be used in conjunction with closure signage.
- Signs must not encroach on footpaths or bicycle lanes unless the path is wide enough to accommodate them. Consider vulnerable road users with impaired vision, mobility or cognitive limitations. A delineation device (e.g. a traffic cone) should be placed at the base of signs on footpaths or bicycle lanes. If the width of the footpath/cycle path is insufficient, then an appropriate TGS must be determined to manage the path users.
- Avoid placement that could direct road users into incorrect or dangerous situations.
- Signs or their supports must not obstruct visibility of other devices (e.g. signals, other signs, etc.), should not obstruct the view between different road users, or create a hazard for pedestrians or cyclists. Signs on narrow medians along the roadway might have reduced visibility. Increase the height of signs or consider using a VMS to improve visibility due to obstructions (e.g. parked cars).
- Signs must not be used where their legibility and effectiveness are compromised by contamination and/or marks and abrasions. Signs must be kept clean, especially in dusty or muddy conditions.
- Signs that conflict with the works must be removed or covered. Consider weather conditions (e.g. wind, rain) when choosing a suitable covering. It is essential that all signs at the worksite or varied travel route accurately represent the prevailing conditions at all times. Covering, altering or replacing signs may need to be approved by a RIM. Ensure that permanent signs are not damaged when doing so. Restore these signs when works are completed.
- Covering signs may be difficult due to height or size of the sign. When covering signs that are high, ensure this is done in a safe manner. All conflicting signs must be covered or removed, so it is important to identify any possible issues before implementation.
- Sign messages must not be permitted to be formed with tape, for example, Lane Status signs and mocking speed numerals in tape.
- Sign support structures must not be left in place without signs attached.

2.5.4 Sight distance

Checking sight distance is Step 2 in sign placement (see Section 2.5.3).

It is the designers responsibility to ensure that signs are located so that drivers' sight distance to the sign is maintained, where they can be seen and read in adequate time by the intended road user. If during the design phase the identified position for signs will not meet the sight distance requirements, the design of the TGS should advance the sign location up to one sign spacing (see Table 2.2). If it still does not meet sight distance requirements, a sign must be located in its original position and an additional sign should be located one sign spacing in advance. Consider also sight distance of road users entering from side roads or private driveways. The aim is to give road users sufficient warning when approaching a hazard (see Section 2.5.3).

Consideration of suitable sight distances will enable road users to perceive and react to a hazardous situation on the road ahead resulting in safe and efficient traffic management. Sight distance is best when designed to be as long as practicable, but is often restricted by the following:

- horizontal and vertical curves in road
- overgrown vegetation
- obstructions (e.g. safety fences, boundary fences, barriers, parked cars, street furniture, landscaping, signs)
- railway crossings
- bridges
- traffic queues

- weather (e.g. line marking visibility in the rain)
- time of day (e.g. night visibility, glare)
- sealed or unsealed roads
- type of road users at the site (e.g. over-dimensional vehicles, motorcyclists)
- vehicles closely following each other
- other local site features.

In addition to the considerations for sight distance for vehicles, sight distance must be also be considered to access points in or out of the worksite to pedestrian or cyclist paths to prevent a conflict.

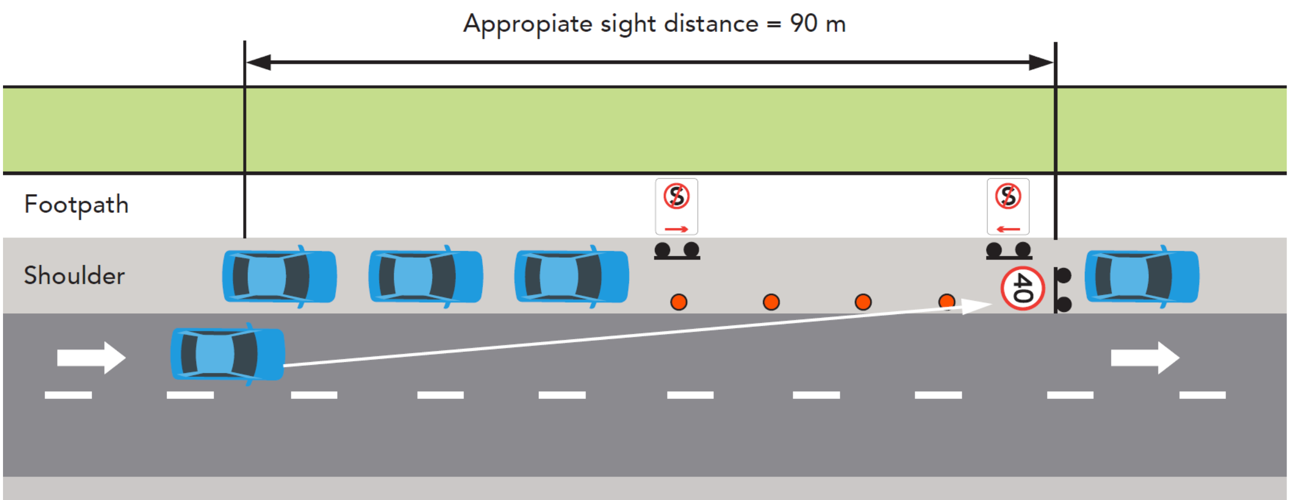
Recommended sight distances measured to a traffic control device from the driver of an approaching vehicle, in relation to speed is shown in Table 2.3. These distances are based on the required sight distance for a driver to be able to react appropriately to the hazard or instruction detailed by the sign. Detailed steps and calculations associated with assigning appropriate sight distances are described in detail in Austroads Guide to Road Design Part 3 and Part 4a.

Table 2.3: Recommended sight distances to a traffic control device

Speed (km/h)	Distance (m)
≤ 45	50
46 - 55	70
56 - 65	90
≥ 66	Two times the speed (km/h)

Figure 2.3 is an example of sign placement when considering sign visibility and recommended sight distance. The arrow represents the sight distance required for a road user to perceive and react to the message being communicated by the sign ahead for a speed of 60 km/h. In this case, parking has been restricted for a portion of the roadside to ensure that sight distance to the sign is maintained.

Figure 2.3: Appropriate sight distance



Note: This is an example for a 60 km/h scenario.

2.5.5 Road categories

These are the designations given to roads for application of guidance material in AGTTM. TTM practices may vary according to the road category to ensure the objectives of this guidance can be met. Consider the requirements of specific jurisdictions for each road category when designing appropriate TTM. For details see AGTTM Part 8.

2.5.6 Traffic volume

Traffic volumes form a key input to the design of a TGS, aiding an understanding of how much road capacity reduction is feasible and at what times. They change relative to the time of day and day of week, impacting effective and efficient traffic management. For example, the afternoon school peak period often creates a spike in traffic volumes and can be an undesirable time to close traffic lanes due to the loss of road capacity creating excessive disruption such as queuing. This in turn, may necessitate the need for nightworks which then requires consideration of the impact of works-related activities at night such as noise and temporary lighting.

Improved planning, coordination and approvals during the planning and scheduling phase assist with managing traffic volumes during unplanned events and proactively mitigate risks. When higher than anticipated traffic volumes occur at a site, the TGS should be re-evaluated and an alternative plan created to avoid long queues and delays. Extensive queueing creates a risk to road users who are not expecting a queue under normal circumstances whilst travelling. A decision on the need to produce alternative traffic control is based on consideration of all prevailing circumstances such as:

- the scope of the works (e.g. do right turns need to be prohibited? Has the traffic lane been narrowed or shifted to reduce speed? Is a detour required? (see Section 3.8))
- the time of day (e.g. do works need to be confined to nights or weekends due to road capacity and traffic demand?)
- road condition (e.g. Is the road rough or unsealed?)
- specific weather conditions
- traffic volumes at alternative routes
- signalled intersections at locations close to the works
- unplanned events affecting the adjacent road network (e.g. traffic incidents)
- planned events such as festivals and their duration.

2.5.7 Traffic lanes

Every attempt should be made to maintain full capacity on roads, particularly during peak periods in built-up areas. Works may need to be re-scheduled to off-peak periods (nights, weekends) so that peak lane capacities are maintained particularly where roads are affected by schools, hospitals or other generators of significant peaks in traffic. It is recognised that this is not always practicable. Guidance on reducing the number of traffic lanes is detailed in Table 2.4. Factors to consider when using Table 2.4 include:

- All works require competent persons to be involved in the planning, assessment and approval of design.
- The word intersection applies where traffic in the considered direction is controlled by signals, a roundabout, stop/give way controls or other control devices.
- Table 2.4 cannot be used for works extending more than 7 days. For these longer works, request further input of a competent person (e.g. engineer) regarding traffic demand and capacity at the site.
- Parking bans, lane reversal or both might be needed if this guidance cannot be followed.
- If the desired number of open lanes cannot be achieved for the expected traffic volumes, more detailed traffic analysis should be undertaken by a traffic engineer.

Table 2.4: Desirable number of open lanes for each direction of travel

Mid-block (one direction) (vph)	Within 200 m of controlled intersection (upstream or downstream) (one direction) (vph)	Desirable number of open lanes for direction considered
≤ 1000	≤ 500*	1
1001 - 2000	501 - 1000	2
2001 - 3000	1001 - 1500	3
3001 - 4000	1501 - 2000	4

** Prohibit right turns out of a single lane if the proportion of heavy vehicles and the volume of opposing traffic is high. Seek further assistance if needed.*

The traffic volumes shown in Table 2.4 may need to be reduced under certain conditions as described below:

- Reduced by 30% if the pavement surface is rough or unsealed.
- Reduced by 50% if the horizontal geometry through the work site is reduced to a speed value of less than 40 km/h.
- Reduced by 20% if the volume of heavy vehicles exceeds 10% and the road is downward, level or easy upgrade.
- Reduced by 40% if the volume of heavy vehicles exceeds 10% and the road has sustained upgrade > 5%.

2.5.8 Lane width

The minimum width for lanes carrying traffic around, through or past a worksite is shown in Table 2.5. Lane widths should consider accommodating the swept path of large vehicles expected to negotiate the worksite.

Table 2.5: Minimum lane width

Criteria	Lane width (m)*
General Lane widths	
≤ 60 km/h	3
> 60 km/h	3.5
Curve with radius 100 – 250 m	Curve widening 0.5 per lane
Curve with radius < 100 m	Consider swept path of long vehicles (e.g. buses, trams)
Approach lane is < 3 m wide	Equal to approach lane
Two-way residential street	5.5 (sum both ways)
Shuttle flow with active control	3.5
Shuttle flow operation	
Shuttle flow on residential streets (see Section 5.4.4)	Maximum 3.5

*Note: *This does not apply to curves of radius 250 m or less, or locations where there are fixed vertical obstructions such as fences or safety barriers within 30 cm of the edge of the lane on one or both sides. Where these conditions apply, consider widths wider than those listed above to accommodate large vehicles.*

Consideration is also to be given to cyclists and pedestrians. See Section 3.10 for further details on traffic management regarding pedestrians and cyclists.

2.5.9 Speed

All references to speed are the posted speed (temporary or permanent) unless the speed of traffic is substantially higher or lower (greater than 10 km/h difference), in which case the speed of traffic must be used.

Prior to undertaking any works, the speed limit selected must correspond to the working environment and be verified by appropriate personnel prior to starting. Speed limits must be monitored throughout the completion of works to ensure compliance with AGTTM.

2.6 Variations to Design

Having reviewed the potential risks, design steps and traffic management options available within this guidance document, where particular site conditions prevent their application, consider:

- variations (e.g. distances) to the TMP or TGS may need to undergo risk assessment tailored to the worksite by a competent person in accordance with the relevant authority requirements
- variations may require the approval of the relevant road infrastructure manager
- the use and reason for changes (e.g. additional or reduced number of traffic control devices) must be recorded within the Daily record keeping documentation as a variation.
- trials or innovative treatments proposed will be undertaken in accordance with jurisdictional requirements, and as approved by the relevant road authority. This could include new or improved devices or innovative installations and layout of devices which are encouraged to be used where possible.

3. Around the Worksite

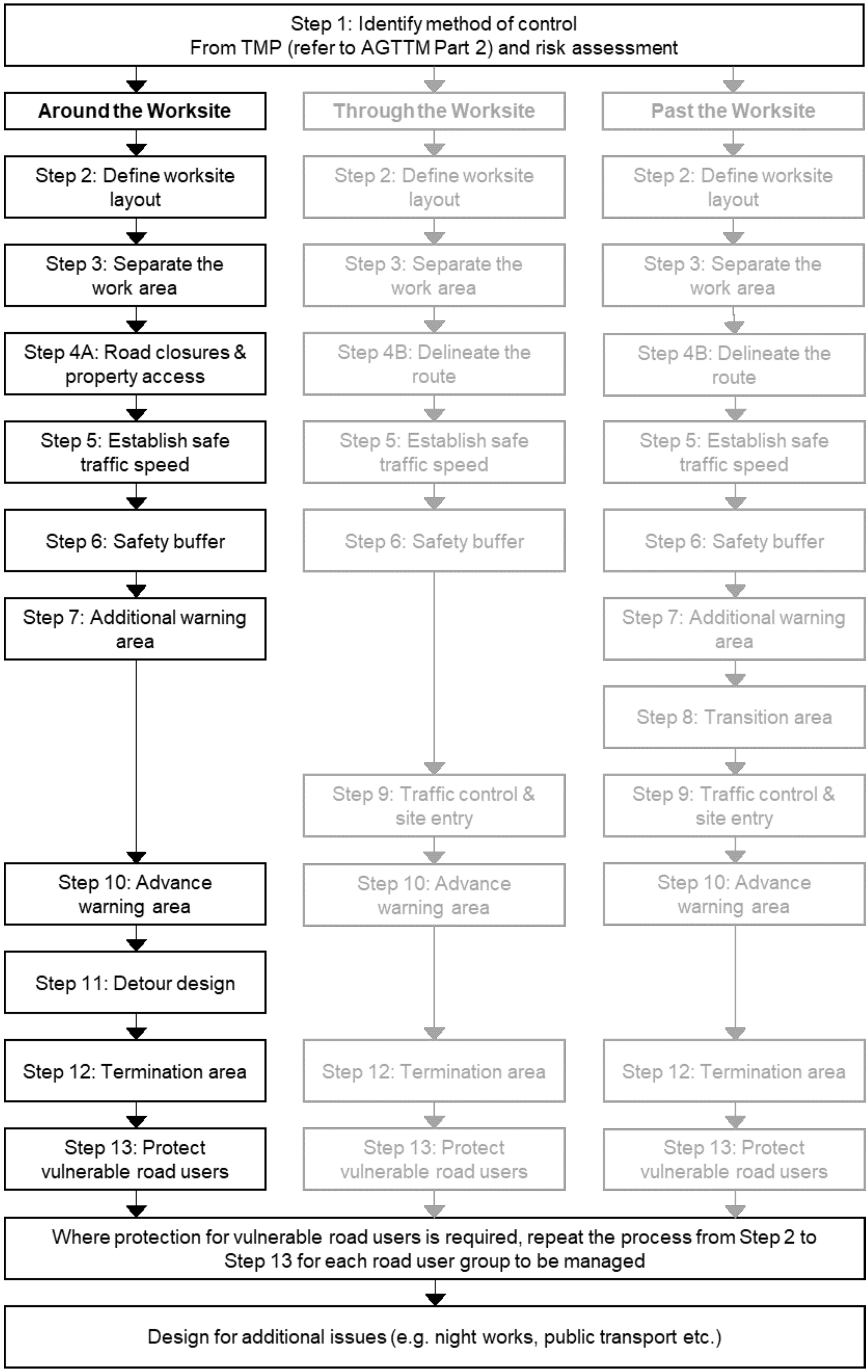
3.1 General

Design for TTM 'around' the worksite involves methods of hazard elimination, when the entire work area (including all vehicles and plant) is located 6 m or more from the nearest clear edge of a traffic lane or separated with a permanent rigid road safety barrier. Figure 3.1 details the design steps for traffic management around the worksite. If it is not 6 m or more clear of traffic, or separated by a permanent rigid road safety barrier, the traffic management method is no longer 'around' and you need to consider either through the worksite (see Section 4) or past the worksite (see Section 5). Around methods are applied in situations where road users are required to be completely removed from the worksite for the duration of works.

Traffic can be managed around the worksite by one of the following methods:

- detours via existing roads:
  - when traffic in one or both directions is detoured via an existing road (including service roads), suitably located to carry traffic around the worksite.
- detours for heavy or over-dimensional vehicles:
  - special detours for heavy or over-dimensional vehicles are required if the height clearance or load carrying capacity of the road has been temporarily reduced due to works or other factors, or if the height clearance or load carrying capacity of the original road has been temporarily reduced
  - in these cases, other (lighter) vehicles will require 'through' (see Section 4) or 'past' (see Section 5) the worksite traffic management
- detours via a sidetrack:
  - a temporary roadway may be constructed beside or near the existing roadway, adjacent to the worksite, usually within the same road reserve. It may cater for one or both directions of travel.
  - the sidetrack will be separated from the work area by at least 6 m at all locations or it will be considered to be past the worksite (see Section 5)
- contraflow:
  - when traffic flow is changed to travel in a direction opposite to the normal flow on a one-way carriageway and is separated from the worksite by permanent rigid road safety barriers or the median width is of 6 m or more
  - two-way flow of traffic is maintained at all times on one carriageway of a multilane divided road
  - for contraflow where the worksite is separated from traffic by a double barrier line or with median widths of less than 6 m, the method of control is to be designed as 'past' the worksite (see Section 5)
- other:
  - When works are more than 6 m clear of the traffic lane, but a detour, sidetrack or contraflow is not used. For example, drainage work on a rural road where there is an overtaking lane that is closed to provide separation between traffic and the worksite eliminates the opportunity for road users to overtake.
  - where it is possible to laterally shift (see Section 5.9.1) traffic away from the work area, achieving a 6 m clearance, by using the opposite shoulder and reducing the number and width of lanes within the roadway.

Figure 3.1: Design steps for around the worksite methods

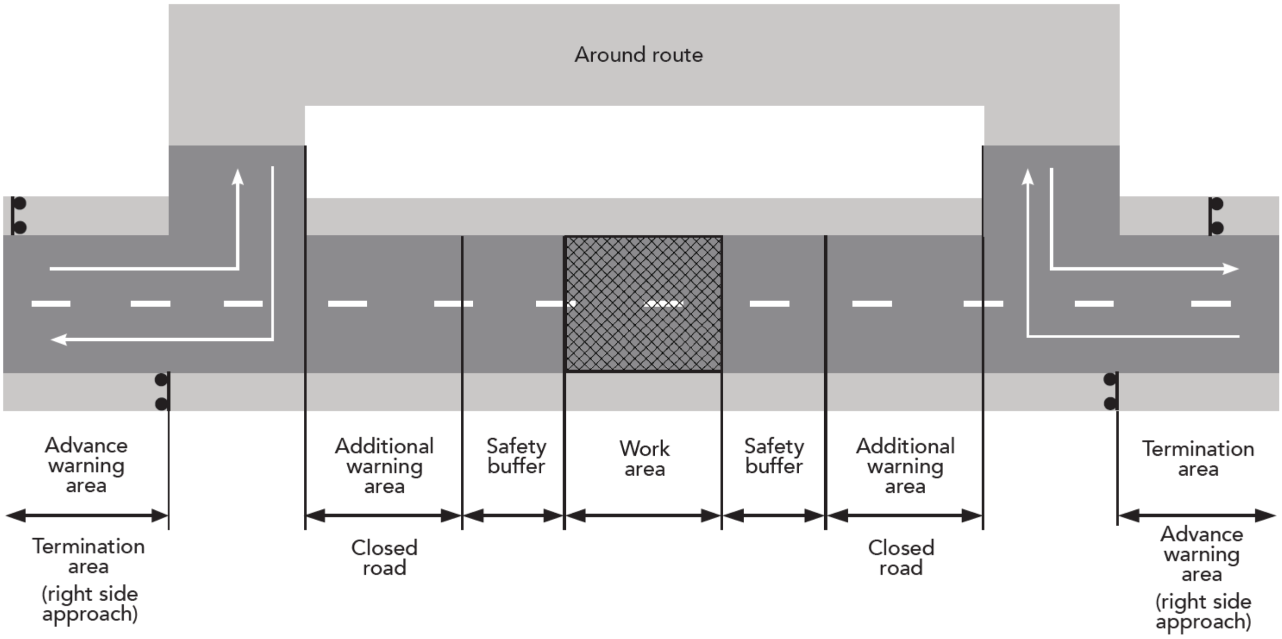


3.2 Worksite Layout

The work area design must allow for movement of road workers, equipment, materials and vehicles, including sufficient waiting and storage space for TTM components. The size and position of the work area must enable the worksite to be managed effectively for the safety of road workers and road users. The size and position may not be consistent for the whole duration of work depending on changes in project tasks or location. This is to be considered when preparing a TGS, with appropriate risk assessment.

Figure 3.2 illustrates the concept of zoning within a typical worksite that uses 'around' traffic management methods for road users approaching on a two-way road. This diagram is not an example of how to install traffic control devices and is not to be used as a TGS diagram.

Figure 3.2: Typical layout for around the worksite



3.3 Separate the Work Area

Providing a physical or visual barrier to protect the work area reduces the risk of incidents between vehicles, road workers and vulnerable road users. Treatments are also designed to reduce the potential for unwanted intrusion into the work area. Methods used for ‘around’ are based on the clearance provided between the general public and the works as detailed in Section 3.1. Treatments and devices required are detailed in the following sub-sections of Around the Worksite:

- Section 3.4 Road closures including Section 3.4.1 Property access
- Section 3.5 Safe traffic speed
- Section 3.6 Safety buffer
- Section 3.7 Advance warning area
- Section 3.8 Design and traffic management
- Section 3.9 Termination area
- Section 3.10 Vulnerable road users
- Section 3.11 Public transport.

3.4 Road Closures

A road closure involves the complete closure of all trafficable lanes to all road users to ensure the safety of road workers and road users whilst works are underway. Examples of when to use this treatment and how are as follows:

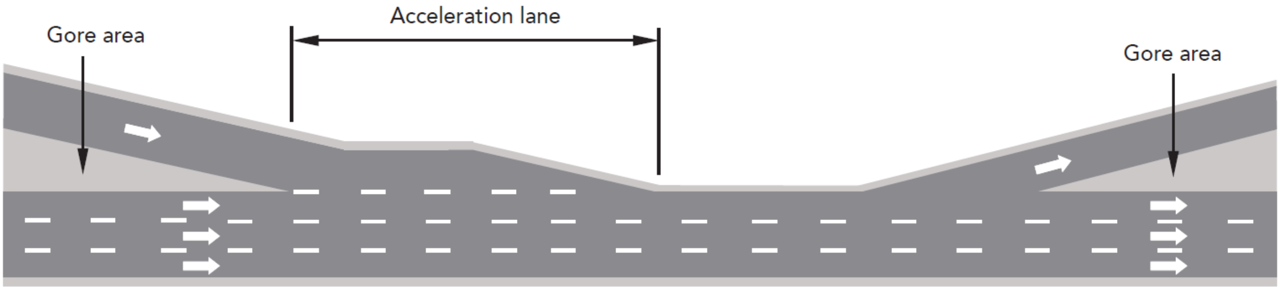
- works resulting in delays of more than 15 minutes:
  - provide notice of closure to the relevant stakeholders if not already done. Notice periods and processes to close a road may vary between jurisdictions.
  - set up a detour route (see Section 3.8) and access to adjacent properties if required (e.g. for local traffic to their homes) (see Section 3.4.1)
- an emergency:
  - for example, a traffic crash or fire where a road is closed immediately by emergency services to secure the area and the relevant authority notified immediately
- unsafe road conditions:
  - for example, floods, slips or snow where roads are closed immediately by the police or other emergency services in consultation with the relevant road authority
- events (see AGTTM Part 10)
- deep excavations (or other severe hazards) are being undertaken and use of a road safety barrier to protect the works or road users is not practical or justified.

When implementing a road closure, note the following:

- for all road closures the ROAD CLOSED sign must be used in conjunction with barrier boards at the start of the site to prohibit general road user access.
- the areas of the road corridor pedestrians and cyclists are currently using, and how can they be provided with a direct and safe facility during the road closure?
- reducing the speed of approaching road users where required (see Section 5.5).
- reducing the number of traffic lanes where required (see Section 2.5.7). For example, on a two-lane one-way road, the right lane would need to be closed upstream from the road closure.
- if an approach or exit lane is closed at an intersection, the corresponding approach or exit lane on the opposite side of the intersection must also be closed.
- traffic control vehicles may be used to physically obstruct access to closed roads to supplement delineation devices if delineation devices alone are insufficient.
- if the worksite blocks a side road a detour should be provided (see Section 3.8)
- if a motorway exit is temporarily closed, closure signs must be installed:
  - in advance of the previous exit if traffic is detoured through said previous exit
  - in advance of the closed exit if traffic is detoured through the next exit.
- Closures at on and off-ramps must be reinforced with a line of traffic cones at appropriate site distance from the work area (see Section 2.5.3). The traffic cones should be placed in a continuous line or chicaned (see Section 5.9.2) to slow road users, assist in re-enforcing the closure and define work vehicle entry points. Traffic cones must be placed 1 m apart to stop road users from driving through, and advance warning signs are provided as detailed in the previous dot points.
- If works are within the gore area or acceleration lane of an on or off-ramp, the ramp should be closed as detailed in previous dot points.

Figure 3.3 illustrates an example of a gore area and acceleration lane. This diagram is not an example of how to install traffic control devices and is not to be used as a TGS diagram.

Figure 3.3: Gore and acceleration lane



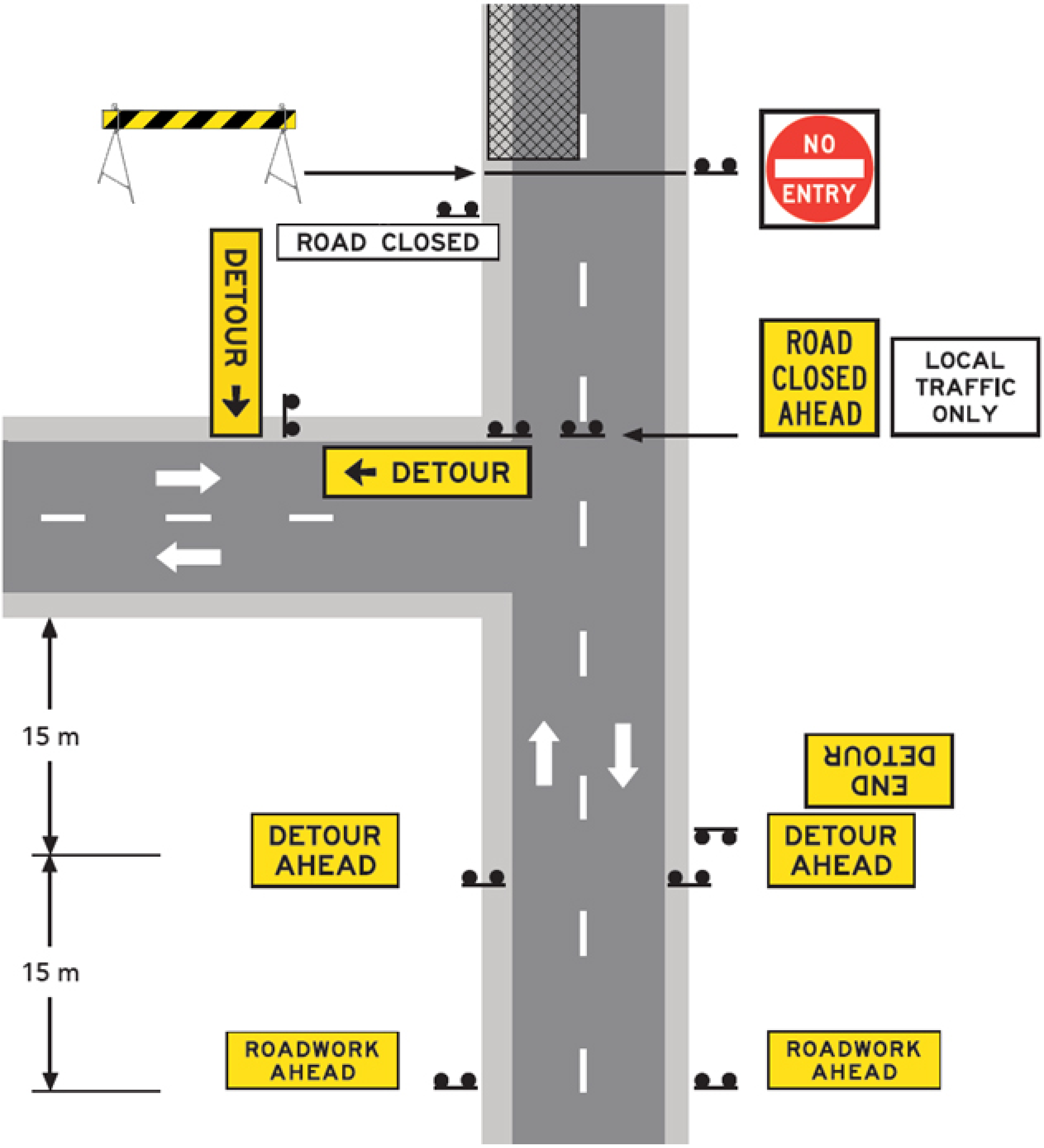
3.4.1 Property access

Road closures must consider the impact on property access. Where access to properties is affected by the road closure, the following treatments should be considered:

- Negotiate a set period of time to close or restrict access with stakeholders.
- Provide an alternative access point.
- Allow local traffic to travel through the worksite with a delineated path or guidance from a traffic controller. A LOCAL TRAFFIC ONLY sign should be erected beside the access point. Large gaps should not be left between delineation devices (e.g. traffic cones) at access points to avoid general traffic passing through by mistake or intentionally.
- Allow pedestrian access only. Locals will need to park elsewhere during this time.
- In rural locations an appropriate detour may be a considerable distance from the actual road closure and road users may require additional signage (e.g. VMS) on closure distance.

Figure 3.4 illustrates an example detour which allows local access. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram. Distances shown are based on Table 2.2 and a speed of 50 km/h.

Figure 3.4: Detour with local access



3.5 Safe Traffic Speed

The management of speeds chosen by road users is a crucial contributor to a safe worksite. Prior to undertaking work on any site, the following must be checked:

- the speed limit enforced on road users is correct
- the speed limit is checked prior to starting work
- the speed of road users is monitored for the whole worksite.

The chance of a crash is reduced at lower traffic speeds because the road user has more time for decision making, is less likely to lose control, and has the ability to take action that will result in the vehicle stopping quicker. At lower speeds, if there is a collision, there is less impact involved, reducing the risk of severe injury. Treatment options to reduce traffic speeds include:

- temporary speed limits (see Section 5.5.1)
  Note temporary speed zones at worksites are required to meet certain workplace safety requirements, including the protection of traffic controllers and workers on foot.
- narrowing lane widths (see Section 2.5.8)
- temporary speed humps (see Section 5.5.2)
- flashing lamps, flares or illuminated signs
- close spacing of delineation devices (see Section 5.4)
- road safety barriers (see Section 5.3.1) or fences along traffic lanes
- visibility screens (see Section 5.3.3)
- tapers (see Section 5.9.1). If tapers are used, place traffic cones on the edge line or shoulder from the start of the temporary speed zone to the taper.
- offsetting traffic cones by placing them on both sides of a lane, but traffic cones on one side are offset from traffic cones on the other side by half a cone spacing
- traffic control (e.g. PTCD, traffic controllers) (see Section 5.10)
- enforcement, subject to road policing priorities and availability. Enforcement should not be relied upon as a key element of design.

A combination of the above treatments should be used when road users are not following temporary speed limit signs and safety is compromised.

The following must be checked:

- the risks associated with road workers (especially traffic controllers) and road users, including vulnerable road users
- sight distance to the worksite
- edge clearances and lane width
- the frequency of conflicts or hazards at the site
- traffic flow and delay reduction
- road geometry and characteristics
- Will vulnerable road users (see Section 3.10), including on-road cyclists, be separated from other traffic or does the design rely on creating a safe, low speed mixed traffic environment?
- Worksite and road worker safety requirements take precedence (if lower) over speeds for traffic safety when deciding on a speed limit.

3.6 Safety Buffer

Safety buffers provide additional protection for road workers and road users on the approaches to and extending around the work area. Safety buffers are not required on departure, however if a vehicle can approach the worksite from either end, a safety buffer should be provided (see Figure 3.2).

No works or road workers must be permitted within the safety buffer and the safety buffer must be kept clear of all types of work vehicles, plant, equipment, storage and stockpiled material.

No traffic control devices (e.g. signs, delineation) must be placed in the safety buffer. These belong in the advance warning area or additional warning area. The safety buffer may be used as an access point to the worksite however, road workers and vehicles should only enter under the supervision of a lookout or traffic controller to reduce the risk of traffic following them into the site.

A safety buffer must be provided immediately in advance of the work area where the speed is 60 km/h or higher. An area 20 m to 30 m in length is generally sufficient. However, if the work area is hidden from approaching traffic (e.g. by a crest or curve), the length of the safety buffer should be extended to a point which can be clearly seen by approaching traffic. On multilane roads, this may be increased up to 100 m.

Where works are being carried out above the road, a safety buffer of lateral separation is required to ensure road users are protected from falling objects by nets, platforms or other devices. Where works impose a temporary height restriction (e.g. safety platform or flashwork under bridge soffit), notification to and approval from the appropriate authority may be required, see AS 1742.3 for more information. Alternatively, close the respective part of the road (see Section 3.4).

3.7 Advance Warning Area

The advance warning area is critical to the success of ‘around’ traffic management to reduce the risk of confusion to road users regarding traffic control, providing a controlled release of relevant information (e.g. signs) and providing repeated information where appropriate to emphasise danger. Advance warning signs and information also strengthen the delineation of a route and ensure that road users can safely and effectively navigate their way to their intended destinations.

Determine which signs to use and their layout with the road user in mind, avoiding confusion and excessive delay. Avoid driver overload that may cause road users to miss vital information. This can result from too many traffic control devices (i.e. signs), conflicting messages or lack of delineation.

The applicable advance warning signs for ‘around’ traffic management include:

- A Worker (symbolic) sign must be placed on the left side of the roadway in advance of the worksite if road workers or plant are visible to traffic.
- A DETOUR AHEAD sign (or VMS) must be placed to give advance warning of an approaching route to detour around a worksite.

  The first detour marker must be placed no more than 100 m past the DETOUR AHEAD sign (or VMS). Detour markers are mounted horizontally with the arrow either vertically upward, at 45 degrees upwards to the left or right, or horizontally to the left or right.

Figure 3.4 is an example of the minimum signage required for advance warning of a detour. Note that this diagram does not include all traffic control devices required and must not be used as a TGS diagram. Distances between signs within the closed section of road are based on Table 2.2 and a speed of 50 km/h.

3.8 Design and Traffic Management

3.8.1 Detours

Detours provide a temporary route to guide road users around a road closure due to works. It is desirable that detours use existing roads, however detours via sidetracks are possible with specialist road design input (see Section 3.8.2). All detour routes must be designed using roads that are capable of handling the volume and type of traffic that would normally use the closed road.

The following must be considered when designing a detour:

- notice of closure to the relevant stakeholders if not already done so. Notice periods and processes to close a road may vary between jurisdictions.
- safety of road workers and the general community

- types of road users (i.e. pedestrians, cyclists, public transport)
- areas of the road corridor that pedestrians and cyclists are currently using and providing them with a direct and safe facility during the detour
- local parking and property access (see Section 3.4.1)
- traffic signal phasing and timing on, and adjacent to, the detour route
- pavement surface and strength of structures appropriate for the type and volume of traffic:
  - ensure the structural strength of temporary pavement carrying unexpected heavy vehicles
  - ensure the structural strength of roads carrying increased volumes and loads of vehicles and plant
  - monitor pavement for any indication of failure to be dealt with as soon as possible
- load limits and height restrictions
- road width and intersections. Match lane width and speed as closely to the approach road as possible.
- environment (e.g. dust, noise)
- length of a detour
- expected time of road closure and detour. Upgrade line marking to be consistent with the volume of traffic using the detour if it is in use for more than 14 days.
- some remote areas will not be able to provide practicable detours.

Advance warning signs must be placed as described in Section 3.7.

Detour markers must be erected at all subsequent changes of direction and intersections along the route to reassure road users they are on the correct path (e.g. detour in a built-up area through side streets) and they can continue their journey using permanent road sign information. This usually involves directing road users back onto their original route of travel at a point past the worksite. Signs must be erected for each direction of travel affected by the closure and checked to ensure all detour signs are prominently displayed with clear sight distance (see Section 2.5.3 Table 2.3).

Detour markers should be placed well in advance of multilane intersections to allow road users to select the appropriate lane necessary. Follow up with a detour marker at or immediately after the intersection, irrespective of whether a change in direction is required to confirm that the road user is on the correct route.

For long stretches of road, repeater signs should be erected at regular intervals to provide additional assurance for road users. Provide signs at decision points, in rural areas place repeater signs at intersections, or ensure detour signs indicate the requirement to follow existing signs to the relevant location at the end of detour.

END DETOUR sign must be placed at the end of the detour, indicating to road users that they have returned to their original route and permanent signs can be followed.

Detours for heavy or over-dimensional vehicles must be provided if the height clearance or load carrying capacity of the road has been temporarily reduced due to works or other factors, or if the height clearance or load carrying capacity of the original road has been temporarily reduced. These detours require approval by the relevant road authority and a swept path analysis to be conducted. In these cases, other (lighter) vehicles will require ‘through’ (see Section 4) or ‘past’ (see Section 5) the worksite traffic management.

For heavy or over-dimensional vehicles detours, additional signs should be considered. A second physical over-height barrier should be provided if the risk of collision is high or the consequences are especially severe. An example sign is illustrated in Figure 3.5.

Figure 3.5 does not include all traffic control devices required and is not to be used as a TGS diagram. Distances from the bridge (physical barrier) to low clearance warning, successive signs and detour warning are based on sign spacing shown in Table 2.2 and a speed of 80 km/h.

Figure 3.5: Detour for high vehicles

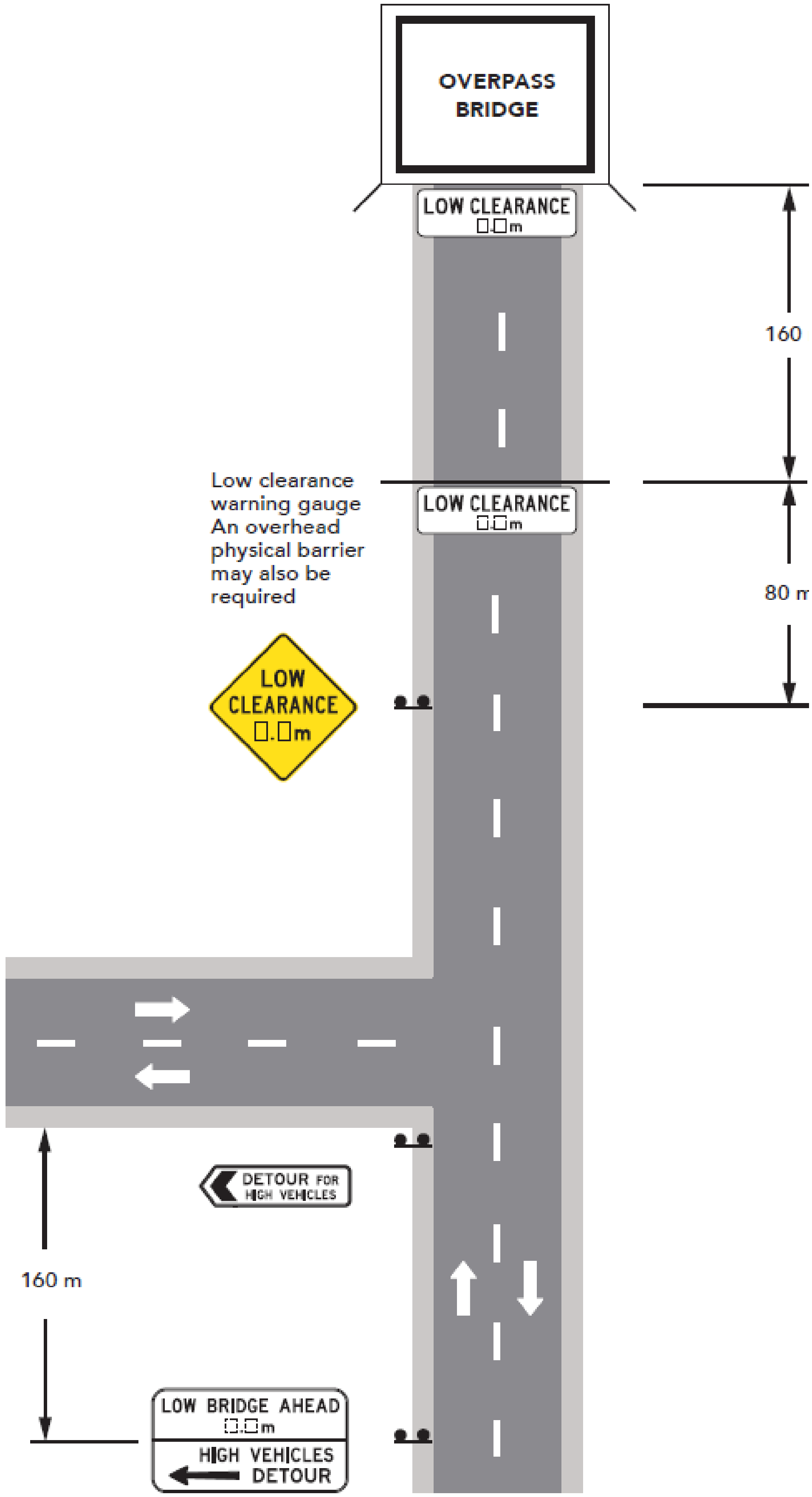
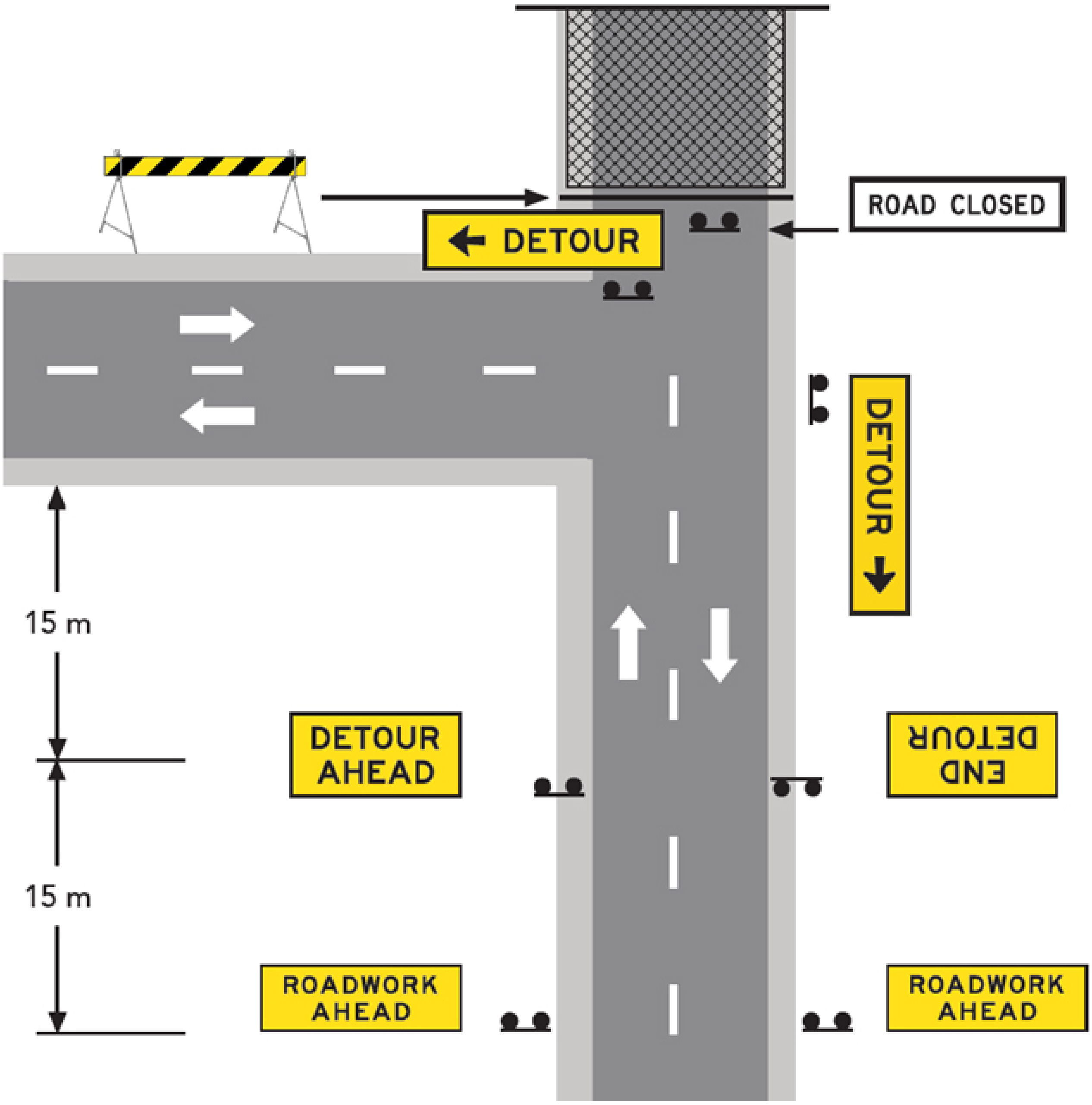


Figure 3.6 illustrates an example of advance warning signs at a road closure and subsequent detour. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram. Distances shown are based on Table 2.2 and a speed of 50 km/h.

Figure 3.6: Approaches to detours



3.8.2 Detours via Sidetracks

Sidetracks provide a temporary route to guide road users around a road closure on a temporary roadway constructed beside or near the existing roadway. This is usually within the same road reserve and may cater for one or both directions of travel. Specialist road design input must be obtained when considering a sidetrack that will require construction. The following must be noted when delineating a sidetrack:

- Use sidetrack advance warning and termination signage as per Section 3.7 (DETOUR AHEAD and END DETOUR signs). However, the sidetrack route itself will rarely require roadworks signage as they are often the same condition as the permanent road.
- Delineation for sidetracks must be the same as the permanent roadway if they have the same alignment, width and pavement surface as the approach route. For sidetracks with alignment, width or pavement surface different to the approach road delineation must include:
  - red delineators on the left-hand side and white delineators on the right-hand side (two-way sidetrack), or yellow delineators on the right-hand side (one-way sidetrack)
  - space delineators as detailed in Table 3.1.
- Temporary hazard markers must be installed at the start of the sidetrack if it begins with a small radius curve or appears that the road does not diverge in some visibility conditions.

Table 3.1: Delineator spacing for sidetracks

Circumstance	Distance (m)
curves up to 200 m radius	6 (outside of curve), 12 (inside of curve)
straights and curves greater than 200 m radius	20
Roads with 1500 vpd or less can increase spacing as follows:	
long flat straights	≤ 100
short and undulating straights	≤ 50
curves greater than 200 m radius	≤ 25

Figure 3.7 illustrates an example of a one-way sidetrack. Note that the 60 km/h limit in this diagram is not fixed to all situations. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram. Note that signage of the opposing direction will typically be in accordance with through or past the worksite.

Figure 3.7: Sidetrack – one-way

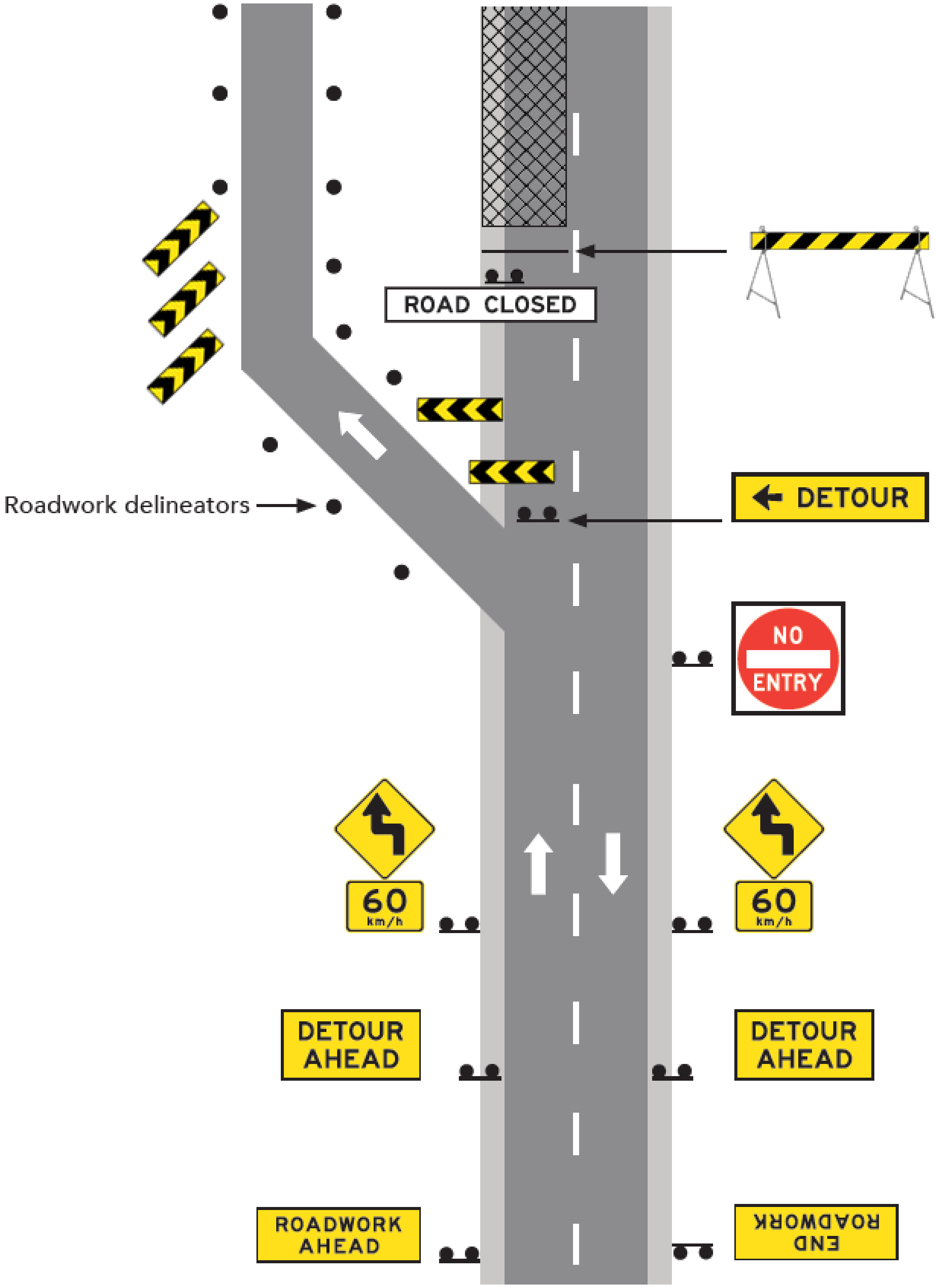
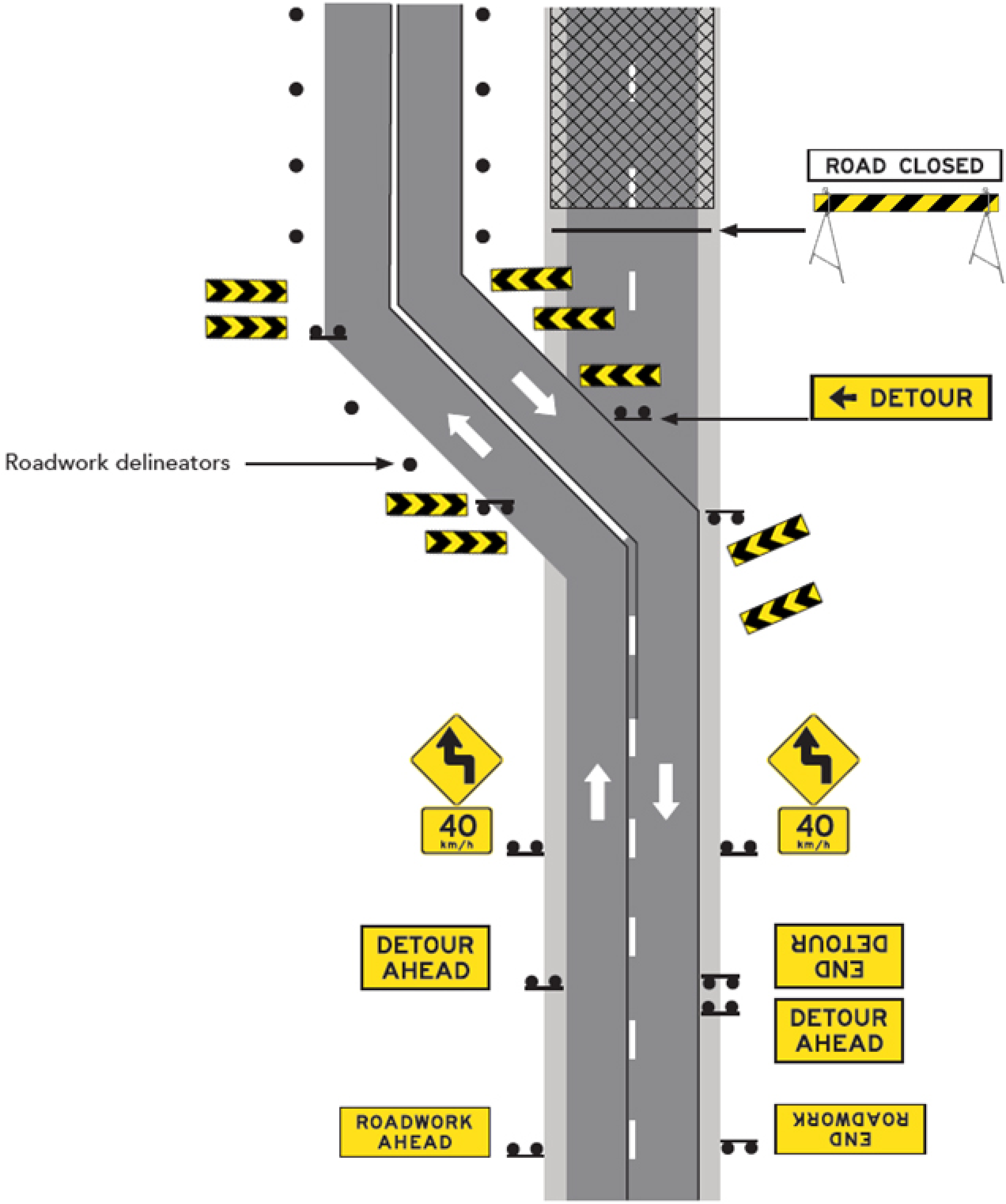


Figure 3.8 illustrates an example of a two-way sidetrack. Note that the 40 km/h limit in this diagram is not fixed to all situations. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 3.8: Sidetrack – two-way



3.8.3 Contraflow

Contraflow provides a route when road works require one direction of a multilane road to be closed and traffic on that side is shifted onto the other side via a temporary or permanent crossover. Traffic continues to flow in both directions at all times and as such, a contraflow is not the same as shuttle flow.

A contraflow is only considered as the 'around' methods where the traffic is separated from the worksite by a permanent rigid safety barrier or a median width of 6 m or more. For roads divided by a double barrier line or with median widths less than 6 m see Section 5.9.3, 'past' the worksite treatment.

The following must be noted when traffic is travelling temporarily in the wrong direction:

- Identify the appropriate speed limit
- A risk assessment and mitigation of any potential hazards resulting from the reversal of direction must be undertaken. For example, fixed roadside objects that are protected in one direction only (i.e. safety barrier and bridge parapet trailing ends that become leading ends).
- Check intersections. They may require to be temporarily modified to ensure that crossing and turning movements can be made safely by all road users. Any movements that cannot be made must be adequately catered for elsewhere within the road network to allow road users to reach their destination. If this requires a detour see Section 3.8.1.
- LOOK BOTH WAYS, TWO-WAY TRAFFIC signs should be provided at side road approaches to warn entering traffic. An example is illustrated in Figure 3.9. This diagram does not include all traffic control devices required and must not be used as a TGS diagram.
- The temporary diversion through the median must be delineated with line marking and/or traffic cones or bollards at 2 m spacing. Note that line marking is the preferred method of separation and is required for long term works. Cones or bollards should only be used for short term works.
- Consider the impact on vulnerable road users such as pedestrians and cyclists crossing two-way roads. If required, movements should be redirected to locations beyond the work area or provide priority crossings (see Austroads Guide to Road Design Part 6A) and uncontrolled mid-block crossing points.
- Opposing flows must be delineated with treatment that removes the risk of encroaching into oncoming lanes, such as:
  - temporary barriers
  - wide centreline treatment
  - barrier line
  - cones or bollards.
- Other supporting measures include warning signs and devices, and pavement arrows should be considered following a risk assessment.
- If considering a wide centreline approach to opposing flows on a contraflow section, see Austroads Guide to Road Design Part 3, and separate opposing flows by 1 m at high traffic speeds and traffic volumes, reduce spacing of delineating devices by half or a quarter of spacing as shown in Table 5.3.

Consider the following at intersections where there is traffic turning through a pedestrian/cyclist crossing point:

- pedestrians with impaired vision, mobility, hearing or cognitive limitations
- containment fences and pedestrian mazes (if required) should be provided to control the location where pedestrians and cyclists cross the road
- traffic management workers may be required to patrol the site and assist pedestrians and cyclists crossing the road
- LOOK BOTH WAYS, TWO-WAY TRAFFIC signs should be provided to face pedestrians about to cross the temporary two-way road. An example is illustrated in Figure 3.9. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 3.9 illustrates an example of signage that can be used as pedestrian warning. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 3.9: Pedestrian warning for contraflow with median strip

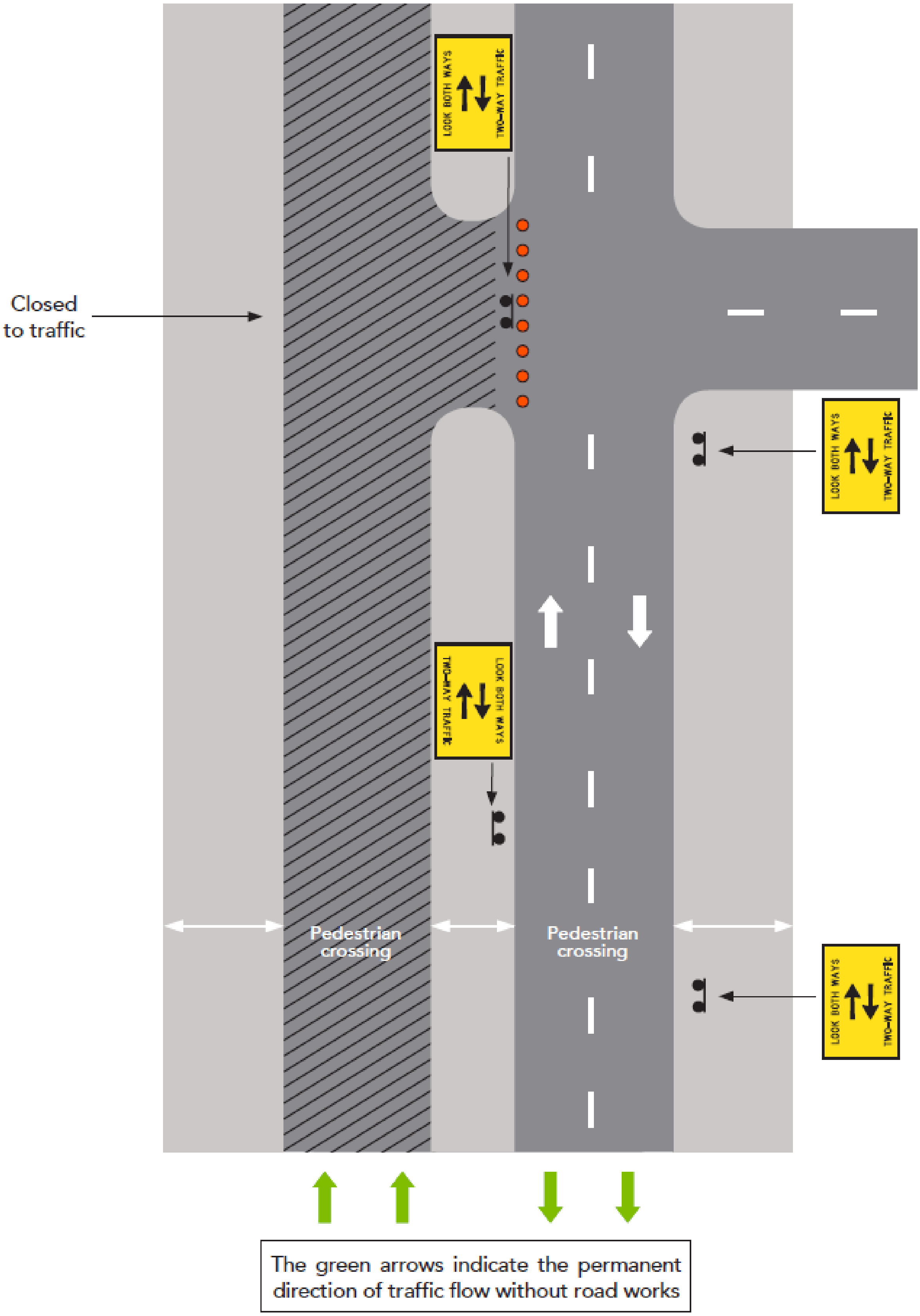
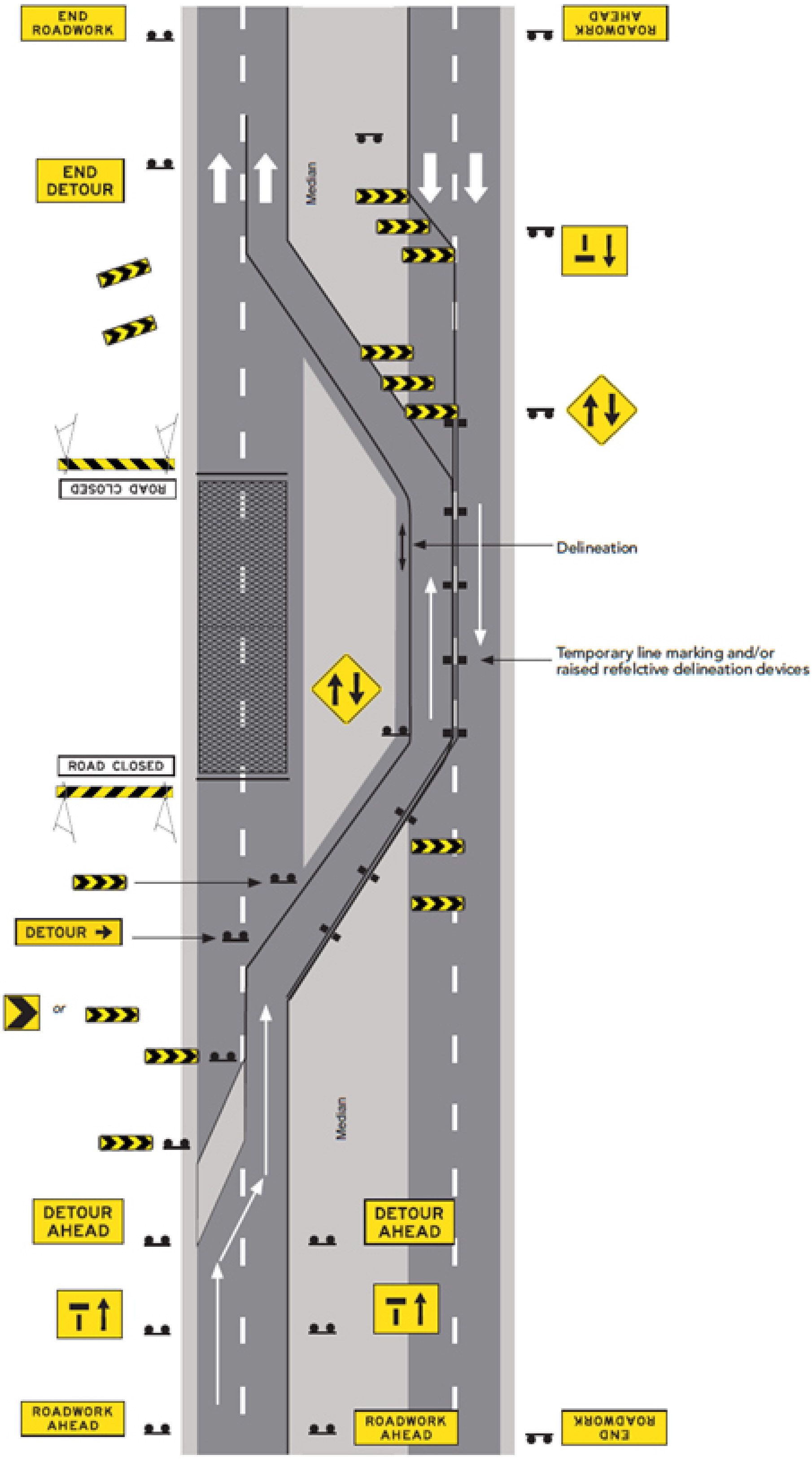


Figure 3.10 illustrates an example of typical treatments for contraflow. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram. Note that temporary line marking has been illustrated in black to differentiate from permanent markings but would be white in practice.

Figure 3.10: Typical approaches to contraflow



3.9 Termination Area

The termination area is located at the end of a worksite (see Figure 3.2) and provides information to road users indicating the end of roadwork or temporary hazard and the resumption of normal traffic conditions. An END ROADWORK sign must be installed in the termination area whenever there is a ROADWORK AHEAD or ROADWORK NEXT X km sign.

Two-way roads require termination signs for outgoing traffic and advance warning signs for incoming traffic as the termination and advance warning areas are shared by road users travelling in opposite directions.

When terminating a temporary speed zone, Speed Restriction or END Speed Limit signs must be used. If this is required at two-way roads, the termination area speed limit stays in line with the speed reduction in the opposite direction for road users approaching the worksite (see Section 5.5.1). Speeds should increase after this zone. The END ROADWORK sign should not be located prior to reinstating of speed (speed increase).

Termination signs should be placed a distance (see Table 3.2) downstream from the last point on the road or verge affected by the worksite. The placement of these signs must be based on a completed risk assessment which considers the driver's behaviour and driver compliance. Consideration of the appropriate distance is important based on the following:

- If the termination sign is placed too far from the worksite, driver compliance with signs may reduce. Where only some drivers choose to comply, an additional risk of differential speeds of drivers in this zone may cause increased risk.
- if the termination sign is placed too close to the worksite, drivers may start to accelerate too close to the worksite, placing workers and other road users at risk.

These distances in Table 3.2 may be adjusted following the completion of a documented risk assessment or to avoid creating an offset speed zone.

Table 3.2: Placement of termination signs

Speed (km/h)	Distance (m)
≤ 55	15
56 - 65	45
≥ 66	Equal to the speed (km/h)

3.10 Vulnerable Road Users

Vulnerable road users include pedestrians, on-road cyclists, off-road cyclists and motorcyclists. Works that impact the road, road shoulder, bike lanes, crossings or pathways are likely to impact on these users. Where works affect vulnerable road users, TTM measures include:

- Road features that are hazardous to motorcyclists and on road cyclists should be treated. This may include transverse and longitudinal changes in pavement level, changes in surface condition and hazards on the road.
- Pedestrian and cyclists should not be led into direct conflict with the worksite or traffic moving around the worksite.
- Where pedestrians and cyclists are diverted onto an existing roadway, the new path must be separated from vehicular traffic by an appropriate traffic control method (e.g. delineation, barriers, warning signs)
- Cyclists may be directed into lanes carrying traffic if the traffic conditions are suitable for mixed traffic.
- Safe and obstruction free temporary paths must be provided where footpaths, bicycle lanes and/or roads used by public transport are blocked by the work.

- Pedestrian and bicycle paths should where possible, be on the same scale and to the same width as any facilities for pedestrian or bicycle traffic that existed prior to the works. If this cannot be achieved, ensure the safe movement of pedestrians, on-road and off-road cyclists through the area is provided to separate vulnerable road users from traffic.
- The diversion of pedestrians and cyclists must consider all appropriate clearances. This includes width and height.
- Shared zones need consideration and where possible, pedestrians should be excluded from the worksite completely.
- Pedestrians with impaired vision, mobility, hearing or cognitive limitations will be considered as part of the design, preparation, approval and implementation of TTM.

3.10.1 Pedestrians

Pedestrians, particularly school children, the elderly, vision, mobility, hearing impaired or people with cognitive limitations are vulnerable road users. Their safety at or adjacent to roadwork sites is an important consideration when planning for roadworks. Where footpaths or shared paths are impacted by roadworks, alternative facilities must be provided such as:

- footpaths
- pedestrian crossings
- crossing points
- refuges.

Whenever possible, design works so that existing pedestrian facilities are not impacted. It is acknowledged however that this is not always possible and alternate provisions need to be made. The following apply when designing pedestrian facilities:

- If permanent pedestrian controls (e.g. signals, signs) are not in place, a traffic management worker should be used to safely direct pedestrians to appropriate crossing points and assist with crossing the road.
- Desirably, if footpaths or pedestrian crossings have been partially closed or temporarily relocated, a temporary footpath should be provided with minimum width of 1.8 m to allow for all pedestrians including those with mobility aids or on the same scale and to the same width as any facilities for pedestrian that existed prior to the works. This width should also be applied to any temporary ramps (e.g. kerb ramps). If these widths are not practicable, alternative routes must be provided with a firm smooth surface and no trip hazards in the following order of preference:
    1. on the side of a road reserve away from traffic
    2. between the work area and road but not in a traffic lane
    3. onto the road either in a lane used for parking or a delineated and protected section of an existing traffic lane
    4. across the road to a footpath on the opposite side with delineation at crossing points and kerb ramps. Consideration is required for persons with impaired vision, mobility, hearing or cognitive limitations. Only use this option if an appropriate crossing facility can be provided (see Austroads Pedestrian Facility Selection Tool).
    5. a traffic controller to safely guide pedestrians around the operation. Only use this option if there is no safe temporary path available.
- Appropriate surfacing must be provided for prams, strollers, wheelchairs or any other mobility aids.
- Temporary paths must be illuminated at night to the level of lighting previously available on the original footpath or crossing, or as referenced in AS 1158.4, whichever is the lesser level.

- Containment fences or longitudinal channelising devices should be installed at unattended worksites or where pedestrians may gain access.
- If falling debris is a risk and there is no alternative footpath available, a structure may need to be provided to protect pedestrians and a traffic controller provided to guide pedestrians safely past the hazard.
- Temporary crossings must be provided as near as practicable to pedestrian routes with the same level of functionality as the crossings they replace. This includes signals and provisions for people with vision, mobility, hearing or cognitive limitations.
- If a temporary crossing becomes unusable or the pavement markings are obliterated, cover any remaining indication of the crossing and install barricades/safety fences on both sides of the road to prevent access crossing. An alternative crossing system must be provided instead.
- If the roadway is converted from one-way to two-way and pedestrian crossings are required, consider the following:
  - Containment fences (see Section 5.3.2) and pedestrian mazes should be considered to restrict where pedestrians cross the road. Ensure that containment fences do not put pedestrians at risk by impacting on visibility between vehicles and pedestrians, including children.
  - Traffic controllers may be required to provide guidance at pedestrian crossings.
  - LOOK BOTH WAYS, TWO-WAY TRAFFIC signs should be placed facing approaching pedestrians on both sides of the crossing.
  - The crossing must be limited to a maximum of two lanes. If this is not practicable, provide a central refuge for pedestrians (see Section 3.8.3, Figure 3.9).
- Where pedestrians have been diverted onto an existing roadway:
  - The pedestrian path must be separated from other traffic with plastic mesh fencing (see Section 5.3.2); and
  - A minimum clearance of 1.2 m should be provided from the plastic mesh fencing to the nearest traffic lane for speeds up to 60 km/h. If this clearance is not practicable, the speed must not exceed a maximum of 40 km/h. If a temporary speed limit is required see Section 5.5.1; or
  - If speed is 70 km/h or more, a road safety barrier system must be used instead of the plastic mesh fencing. Pedestrians must be clear of the deflection zone behind road safety barriers.

For detailed guidance on pedestrian paths see Austroads Guide to Road Design Part 6A.

For detailed guidance on traffic control devices for pedestrian control see AS1742.3.

3.10.2 Cyclists

Cyclists are vulnerable road users. Their safety at or adjacent to roadwork sites is an important consideration when planning for roadworks. Where shared roads, paths or bicycle paths are impacted by roadworks, it is necessary to provide alternate facilities. If a bicycle path exists that will be impacted by roadworks, the preferred approach is to maintain an alternative path not on a shared road. Note the following when designing facilities for cyclists:

- Are cyclists currently sharing traffic lanes, using bike lanes or shoulders, or riding on pathways?
- Relevant warning signs should be used to warn cyclists of any changes.
- If the existing bicycle path is on-road and affected by works, a temporary bicycle path to a similar standard should be provided elsewhere.
- Alternative paths off-road are desirable.

- If there is insufficient width for a temporary bicycle path (same width as the existing bicycle lane), merge cyclists into an existing traffic lane or shoulder. This should include:
  - appropriate approval as required by the Road Infrastructure Manager
  - delineation (see Section 5.4)
  - additional signage should be placed to alert road users of merging cyclists. This signage must be placed at the relevant stopping distance in advance of the closed section of the bicycle lane.
  - consideration of differing speeds and behaviours between cyclists and other road users. Cyclists tend to move slower and in a different manner to other road users.
  - separating cyclists from other road users by time, if the existing traffic lane is narrow or rough, by allowing other road users to manoeuvre past the worksite first and cyclists second. Traffic controllers must be provided to ensure that no other road users follow behind cyclists until they have cleared the area. Multiple traffic controllers will be required, one for traffic and one for cyclists.
  - a temporary speed limit for road users applied to provide safe entry of cyclists into traffic lanes.

3.10.3 Motorcyclists

Although motorcyclists are a part of traffic flow on the roadway, they are considered vulnerable road users. Issues to consider regarding the impact of works on motorcyclists and their safety include:

- Has the location of traffic control devices that might destabilise a motorcycle been avoided on their travel path?
- Is there sufficient clearance of obstructions (e.g. signs, delineation) so that motorcyclists can lean into curves?
- Is the advance warning and delineation adequate for motorcyclists?
- Is the road surface safe for motorcyclists?

3.11 Public transport

The following issues to consider, in conjunction with a risk assessment and TMP, will assist with mitigating the impacts of works on different modes of transport, connections and users.

- Have the needs for public transport been considered, adequately signed and catered for?
- Have the needs of public transport users been considered?
- Have the manoeuvring needs of public transport vehicles been considered?
- Have bus stops been well positioned for safety?

Where activities impact public transport facilities, note the following:

- Approval must be obtained from the relevant public transport authority to conduct works around tram lines and/or bus stops.
- Bus stops should be relocated to a temporary position if required.
- Detours should be provided for bus services if required. Detours must have an acceptable swept path and turning circle for buses.
- Safe passenger access to and from bus and tram stops must be provided.
- Appropriate warning to public transport passengers and road users should be provided by use of warning signs, delineation and/or barriers.

4. Through the Worksite

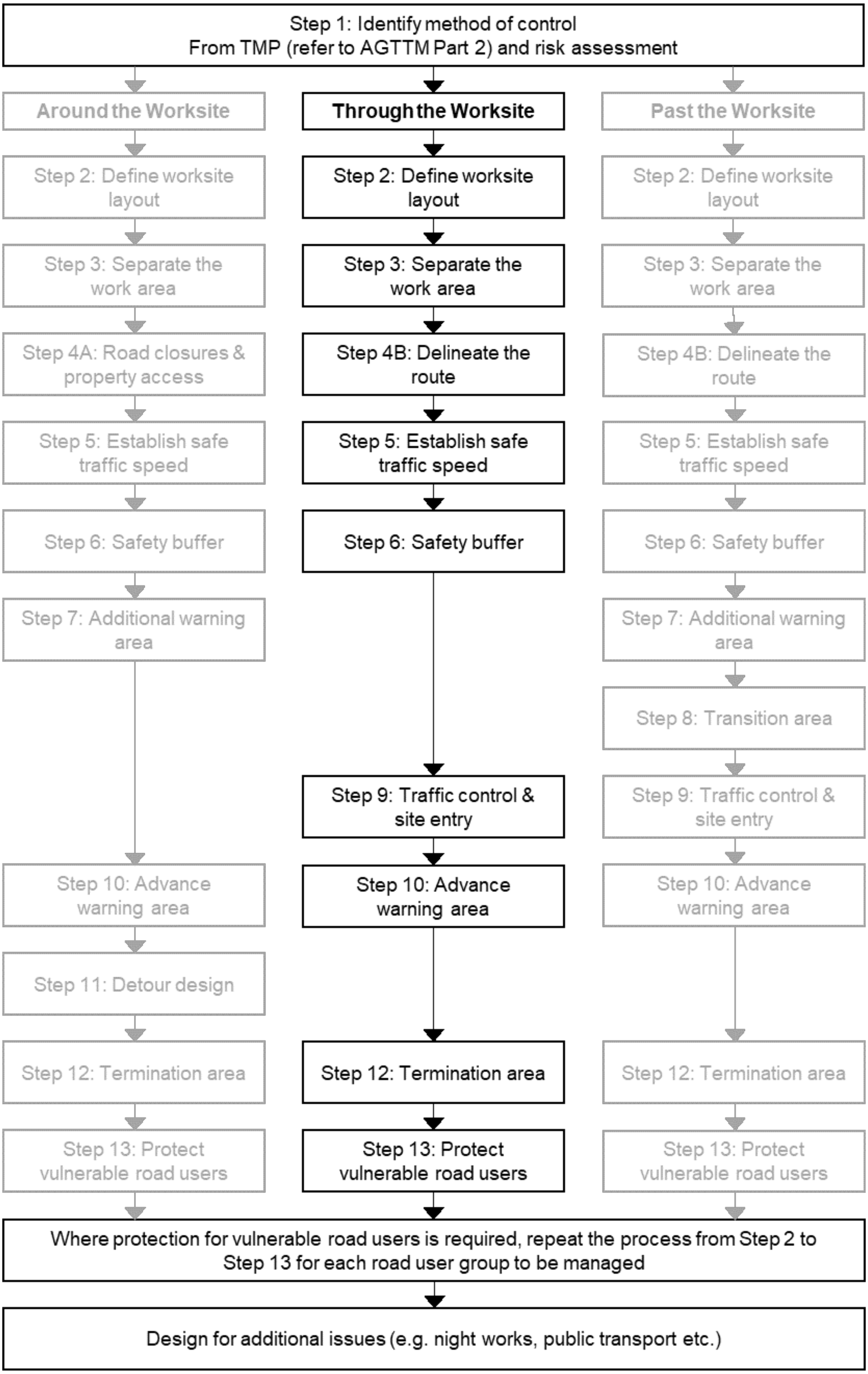
4.1 General

Design for TTM ‘through’ the worksite involves methods of hazard separation, where the passage of traffic through a worksite is permitted during pauses in work activity. This method is most practicable on Category 1 and 2 roads. Figure 4.1 details the design steps for traffic management through the worksite. Where road users cannot safely pass through a worksite, consider either around the worksite (see Section 3) or past the worksite (see Section 5).

Traffic is managed through the worksite by temporarily closing the worksite to all traffic, then reopening to traffic with all works stopped and road workers and equipment out of the way, allowing road users to traverse through (or past) the work area. This may be as shuttle flow (one-way flow), or two-way flow. In either case traffic may be led through with a pilot vehicle. For example, traffic controllers or traffic signals will stop traffic for short periods when required for the works to occur and then release traffic once workers and plant are off the road and it is safe for traffic to proceed. This type of operation is suitable for both one way and two-way roads.

Advance warning is critical to road users, giving them time to process information and slow down on the immediate approach to the work area prior to stopping travel for short periods during the movement of plant or other operations.

Figure 4.1: Design steps for through the worksite methods

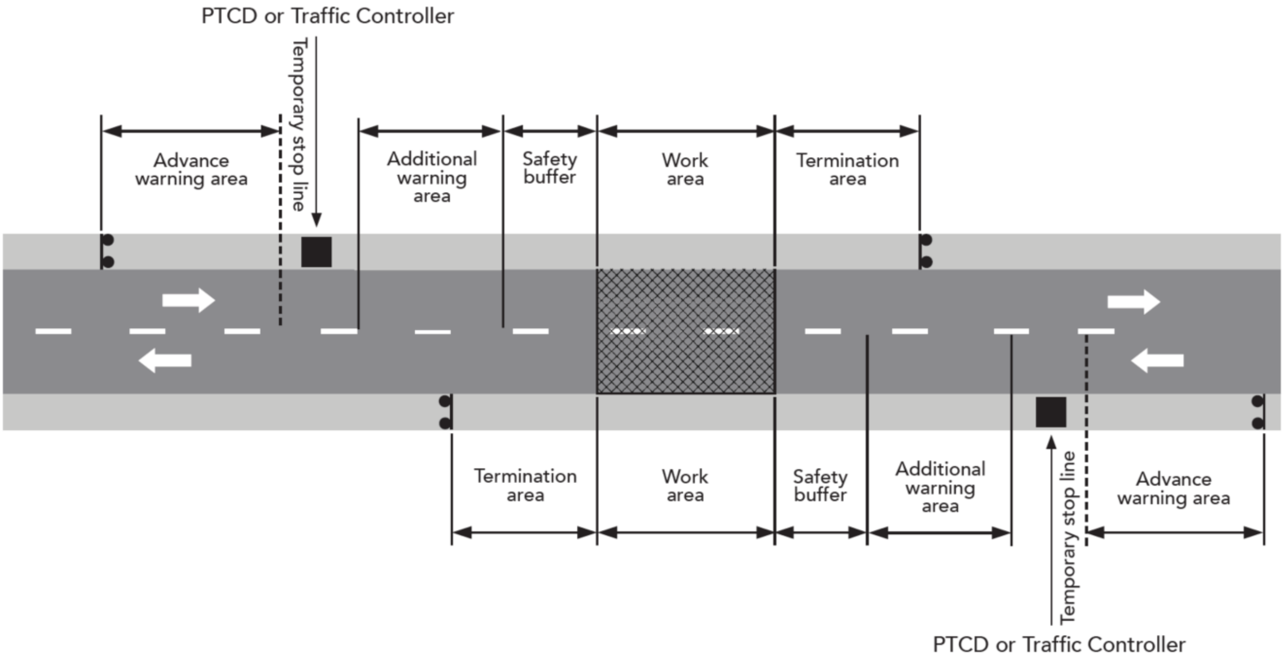


4.2 Worksite Layout

Design the work area to allow for movement of road workers, equipment, materials and vehicles, including sufficient waiting and storage space for TTM components. Ensure that the size and position of the work area enables the worksite to be managed effectively for the safety of road workers and road users. The size and position may not be consistent for the whole duration of work depending on changes in project tasks or location. This is to be considered when preparing a TGS, with appropriate risk assessment.

Figure 4.2 illustrates the concept of a typical worksite that uses 'through' traffic management methods. For one-way roads, the second safety buffer, advance warning and termination area is not required as there will be no vehicles approaching from the other side. This diagram is not an example of how to install traffic control devices and must not be used as a TGS diagram.

Figure 4.2: Typical layout for through the worksite



4.3 Separate the Work Area

Providing a physical or visual barrier to protect the work area reduces the risk of incidents between vehicles, road workers and vulnerable road users. Treatments are also designed to reduce the potential for unwanted intrusion into the work area. Options include:

- PTCD or traffic controller (see Section 5.10)
- road safety barrier systems (see Section 5.3.1)
- containment fences (see Section 5.3.2)
- visibility screens (see Section 5.3.3).

4.4 Delineate the Route

For situations where it is safe for traffic to pass through the worksite, delineation is provided to ensure the safety of road workers and road users whilst providing a clear pathway of travel. Delineation devices include:

- traffic cones
- bollards
- temporary line marking
- raised delineating devices
- post-mounted reflectors
- temporary lighting (if required for night works)
- longitudinal channelising barricades
- temporary hazard markers
- pilot vehicle.

Use of a pilot vehicle involves leading a queue of vehicles safely through the worksite whilst controlling road user speeds and is suitable:

- for long worksites
- when a traffic controller does not have clear visibility of the whole through route
- speed is required to be kept low to minimise potential for damage to the works
- when traffic needs to follow a particular path through the site which is not obvious unless a pilot vehicle is used (e.g. road geometry including vertical or horizontal curves)
- when pedestrians and cyclists require assistance in travelling through the worksite and need to be driven to the end of the worksite (rural roads).

When using a pilot vehicle, PTCDs or traffic controllers must be located at each end of the worksite closure to stop traffic until the pilot car is available to provide guidance. A PILOT VEHICLE with a DO NOT OVERTAKE sign and a vehicle mounted warning device must be mounted on the rear or roof of the pilot vehicle, clearly visible to all following road users.

The clearance between delineation and the edge of the nearest traffic lane should be as shown in Table 4.1. Measure from the traffic-side edge of the delineating device or barricades. These offsets are required because cones or other devices can be dislodged, and the clearance is required to minimise this risk.

Table 4.1: 'Through' edge clearance

Speed (km/h)	Distance (m)
For post-mounted reflectors, temporary hazard markers	
All speeds	1
For traffic cones, bollards, longitudinal channelising barricades or any other delineation device	
≤ 65	0.3*
≥ 66	0.5

** Use this distance when delineating the path. If devices are being used to reduce speeds, as with traffic cones, the offset distance can be reduced to 0 m. Where delineating the edge of a worksite, cones are to be offset from the lane. Where using cones or bollards to reduce speeds, this is to be the closest edge to the defined lane.*

If narrower edge clearance is required, refer to Section 2.6.

If delineation devices are used to separate road users from rigid objects (e.g. concrete barriers, parked plant), temporary hazard markers must be placed beside the first rigid device, pointing to the side of the object which is appropriate for road users to pass. Repeater temporary hazard markers must be placed so they appear as a continuous line to approaching road users. If other signs are used in conjunction with temporary hazard markers, these signs must be placed to appear above, not amongst, the line of temporary hazard markers.

The spacing between delineation devices should be as detailed in Table 4.2. These are maximum measurements and can be reduced (e.g. on curves, at night). If there is a risk that road users may take a wrong turn or take the wrong path, the spacing may be reduced to a minimum of 1 m.

Table 4.2: 'Through' spacing of traffic cones, bollards and post-mounted delineators

Purpose and usage	Speed limit (km/h)*	Recommended maximum spacing (m)
For traffic cones and bollards**		
All purposes	≤55	4
	56 - 75	12
	≥76	18
Protecting freshly painted lines	56 - 75	24
	≥76	60
For post-mounted delineators		
All purposes	≤75	24
	≥76	60

**Use the speed limit where the cones and bollards are installed*
***Consider whether cyclists are using the road shoulder or bike lane and whether an appropriate alternative facility be provided before installing traffic cones or bollards in the area. Where possible, place bollards to maintain a safe cycling facility.*

4.5 Safe Traffic Speed

The management of speeds chosen by road users is a crucial contributor to a safe worksite. Prior to undertaking work on any site, it is important to ensure:

- the speed limit enforced on road users is correct
- the speed limit is checked prior to starting work
- the speed of road users is monitored for the whole worksite.

The chance of a crash is reduced at lower traffic speeds because the road user has more time for decision making, is less likely to lose control, and has the ability to take action that will result in the vehicle stopping quicker. At lower speeds, if there is a collision, there is less impact involved, reducing the risk of severe injury. Treatment options to reduce traffic speeds include:

- temporary speed limits (see Section 5.5.1)

  Note temporary speed zones at worksites are required to meet certain workplace safety requirements, including the protection of traffic controllers and workers on foot.
- narrowing lane widths (see Section 2.5.8)
- temporary speed humps (see Section 5.5.2)

- flashing lamps, flares or illuminated signs
- close spacing of delineation devices (see Section 5.4)
- road safety barriers (see Section 5.3.1) or fences along traffic lanes
- visibility screens (see Section 5.3.3)
- tapers (see Section 5.9.1). If tapers are used, place traffic cones on the edge line or shoulder from the start of the temporary speed zone to the taper.
- offsetting traffic cones by placing them on both sides of a lane, but traffic cones on one side are offset from traffic cones on the other side by half a cone spacing
- traffic control (e.g. PTCD, traffic controllers) (see Section 5.10)
- enforcement, subject to road policing priorities and availability. Enforcement should not be relied upon as a key element of design.

Use a combination of the above treatments when road users are not following temporary speed limit signs and safety is compromised.

Consider the following:

- the risks associated with road workers (especially traffic controllers) and road users, including vulnerable road users
- sight distance to the worksite
- edge clearances and lane width
- the frequency of conflicts or hazards at the site
- traffic flow and delay reduction
- road geometry and characteristics
- Will vulnerable road users (see Section 4.10) including on-road cyclists, be separated from other traffic or does the design rely on creating a safe, low speed mixed traffic environment?
- Worksite and road worker safety requirements take precedence (if lower) over speeds for traffic safety when deciding on a speed limit.

4.6 Safety Buffer

Safety buffers provide additional protection for road workers and road users extending around the work area. This includes on approach, to the work area. Safety buffers are not required on departure, however if a vehicle can approach the worksite from either end, a safety buffer should be provided (see Figure 4.2).

Ensure that no works or road workers are within the safety buffer and keep the safety buffer clear of all types of work vehicles, plant, equipment, storage and stockpiled material.

Do not place any traffic control devices (e.g. signs, delineation) in the safety buffer. These belong in the advance warning area or additional warning area. The safety buffer may be used as an access point to the worksite however, road workers and vehicles should only enter under the supervision of a spotter or traffic controller to reduce the risk of traffic following them into the site.

A safety buffer must be provided immediately in advance of the work area where the speed is 60 km/h or higher. An area 20 m to 30 m in length is generally sufficient. However, if the work area is hidden from approaching traffic (e.g. by a crest or curve), the length of the safety buffer should be extended to a point which can be clearly seen by approaching traffic. On multilane roads, this may be increased up to 100 m.

Where works are being carried out above the road, a safety buffer of lateral separation is required to ensure road users are protected from falling objects by nets, platforms or other devices. Where works impose a temporary height restriction (e.g. safety platform or flashwork under bridge soffit), notification to and approval from the appropriate authority may be required, see AS 1742.3 for more information. Alternatively, close the respective part of the road (see Section 3.4).

4.7 Traffic Control and Site Entry

When considering entry of traffic through the site, safety, trafficability, notification of any changed surface conditions and delineation must be addressed, and risks mitigated. Prior to progressing through the worksite, road users need to be prepared to enter changed traffic conditions and be safely guided through the trafficable path (see Section 5.10 for more information on traffic control). Traffic control may be required:

- to provide warning or information (e.g. delay or follow pilot vehicle)
- to slow down, stop or direct traffic
- to restrict or change the direction of traffic flow
- for lookout duties for road workers during installation of traffic management devices
- in emergency situations.

If not properly designed, the worksite can also impact road users with excessive delays and long queues impacting the operation of adjacent roadways and public transport and increasing risk. It is acknowledged that delays are unavoidable at times, especially for 'through' methods, however keep disruption and delay to a minimum by considering the following:

- Ensure a safe maximum traffic capacity through the worksite.
- Calculate the estimated time of delay when stopping traffic. Inform the relevant road infrastructure manager if delays of more than five minutes (or other time limit specified by the road infrastructure manager) are expected. Outcomes can include:
  - allowing the predicted delays to be imposed
  - restricting the hours of work to specific times of day or night
  - periodically pausing work to allow queues to disperse
  - where substantial queuing is expected, and alternative routes are available, detours are an option (see Section 3)
  - If excessive delays result from an unexpected event (e.g. plant breakdown, traffic incident), ensure this information is communicated to road users and other relevant people (e.g. emergency services) by traffic controllers or other road workers. To avoid major disruption, consider:
    - reopening the road closure and restoring the original level of road capacity if possible
    - finding a suitable detour and re-routing traffic.
- Extra planning beyond the scope of this guidance may be needed if delays are extreme (e.g. laying bridge beams).

When applying traffic control to stop work temporarily and allowing traffic to traverse through the work area use temporary traffic signals, PTCDs or PTCDs with a pilot vehicle to lead each flow of traffic if required and traffic controllers using STOP/SLOW bats. Traffic control must be positioned at each end of the worksite closure, relative to a temporary stop line on the road so that:

- traffic exiting the work area can do so without conflicting with traffic waiting at the temporary stop line
- traffic is stopped until the pilot car is available to provide guidance.

PTCDs or traffic controllers must be used to control the successive movement of work vehicles, plant users and road users within the trafficable area. Traffic controllers may also be required to communicate information regarding delays to road users.

If speed is above 60 km/h, a temporary speed zone must be provided to provide warning and time for road users to slow down (and if required stop) on the immediate approach to the work area (see Section 5.5.1).

4.8 Advance Warning Area

The advance warning area is critical to the success of 'through' traffic management and aims to provide:

- no surprises to road users regarding traffic control
- a controlled release of relevant information (e.g. signs)
- repeated information where pertinent to emphasise danger.

It can also reduce traffic in the area by inducing road users to actively plan alternative routes where possible (refer to AGTTM Part 2). Advance warning signs and information also strengthen the delineation of a route and ensure that road users can safely and effectively navigate their way to their intended destinations. Note the following steps in conjunction with Figure 4.4, Figure 4.5 and Figure 4.6 examples when designing the advance warning area for 'through' methods:

1. Identify the PTCD or traffic controller position.
2. STOP HERE ON RED SIGNAL or STOP HERE WHEN DIRECTED sign must be placed 6 m from the PTCD/traffic controller position (downstream). A temporary STOP line may be installed using temporary removable road marking tape.
3. Four cones should be placed on the centreline spaced 4 m apart starting from the STOP HERE ON RED SIGNAL or STOP HERE WHEN DIRECTED sign position (downstream).
4. Estimate end of queue position (see box instructions below).
5. A PREPARE TO STOP sign must be placed in conjunction with the boom barrier ahead or Traffic Controller (symbolic) or Signals Ahead sign a minimum distance as shown in Table 2.3 from the predicted end of queue, not the PTCD/traffic controller position. This is the primary PREPARE TO STOP sign.

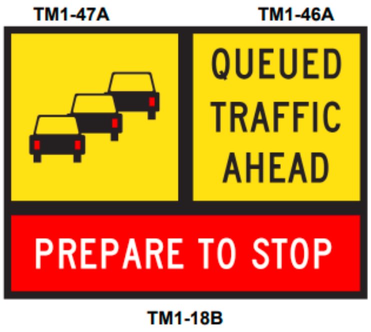
   If the PREPARE TO STOP sign is more than 240 m from the traffic controller, an additional PREPARE TO STOP sign must be placed 120 m from the traffic controller (see Figure 4.5 and Figure 4.6). The primary purpose of this sign is to protect the traffic controller.

   If visibility is lost or the distance from the PREPARE TO STOP sign to the PTCD/traffic controller is more than 300 m, additional signs should be installed at spacing as per Table 4.4.

   Where the conditions above are met and PREPARE TO STOP repeater sign is required, a multi-message sign warning the queue ahead may be used as the primary PREPARE TO STOP sign. If used, this multi-message sign must include the queued traffic symbolic (TM1-47A), QUEUED TRAFFIC AHEAD (TM1-46A) and the PREPARE TO STOP (TM1-18B) signs as shown in Figure 4.3.

   A 60 km/h temporary speed zone must be installed in advance of the primary PREPARE TO STOP sign as per the sign spacings in Table 2.2. Where required, the 60km/h sign must be repeated as per the requirements of Section 5.5.1

Figure 4.3: Queued Traffic ahead multi-message sign



6. A ROADWORK AHEAD sign, or VMS must be placed as per Table 4.4 in advance of the primary PREPARE TO STOP sign position discussed in Step 3.
7. Surges in traffic demand can occur so adequate monitoring of the queue must be undertaken to minimise the risk of end of queue collision. If the end of queue extends beyond the primary PREPARE TO STOP sign position, the distances and sign locations must be adjusted as required using a second traffic controller. If the queue length extends beyond primary PREPARE TO STOP sign position from Step (5), the length of the temporary speed zone (see Section 5.5) must also be extended.

Table 4.3: Estimated queue length

Maximum stopping time (minutes)	Multiplier	
	Ma (multiplier for average vehicles)	Mo (multiplier for oversized vehicles
2	2.4	8
5	6	20
10	12	40
15	18	60
30*	36	120

**A 30 minute stop time is unusual but has been included for some circumstances*

Table 4.4: Additional signs spacing for traffic control

Speed (km/h)	Distance (m)
≤ 45	20
46 - 55	60
56 - 65	180
≥ 66	Four times the speed (km/h)

Figure 4.4 illustrates an example of sign positioning for queues as per the steps above for a speed of 60 km/h where the PREPARE TO STOP sign is less than or equal to 240 m away from the PTCD/traffic controller. This diagram is not an example of how to install all traffic control devices and is not to be used as a TGS diagram.

Estimate end of queue position

Queueing is expected for 'through' methods at stop locations where PTCDs or traffic controllers are positioned, sometimes resulting in collision. Collision can occur when the stationary queue extends past the PREPARE TO STOP sign location, most commonly when speed is greater than 70 km/h or the sight distance of approaching traffic to the end of the queue is:

- less than two times the speed limit in open road areas
- less than 1.5 times the speed limit in built-up areas.

To estimate queue length:

- Count the number of average and oversized vehicles that pass the PTCD/traffic controller position for five (5) minutes.
- Consider whether the majority of vehicles have been average or oversized (i.e. trucks). This will influence the 'multiplier' column used in Table 4.3.
- Multiply the number of vehicles counted by the number in the chosen 'multiplier' column (Ma for mostly average sized vehicles, or Mo for mostly oversized vehicles) using the maximum stop time required at the specific worksite.
- If you are unsure of the maximum required stop time or whether to use the 'average' or 'oversized' multiplier, seek assistance from a competent person or road authority.
- Use the formula below to calculate the estimated queue length:

  (number of average vehicles $\times$ Ma) + (number of oversized vehicles $\times$ Mo) = queue length

If more accurate data is available (e.g. traffic counts), this should be used instead of counting vehicles for five (5) minutes.

Figure 4.4: Avoiding end of queue collisions (≤ 240 m)

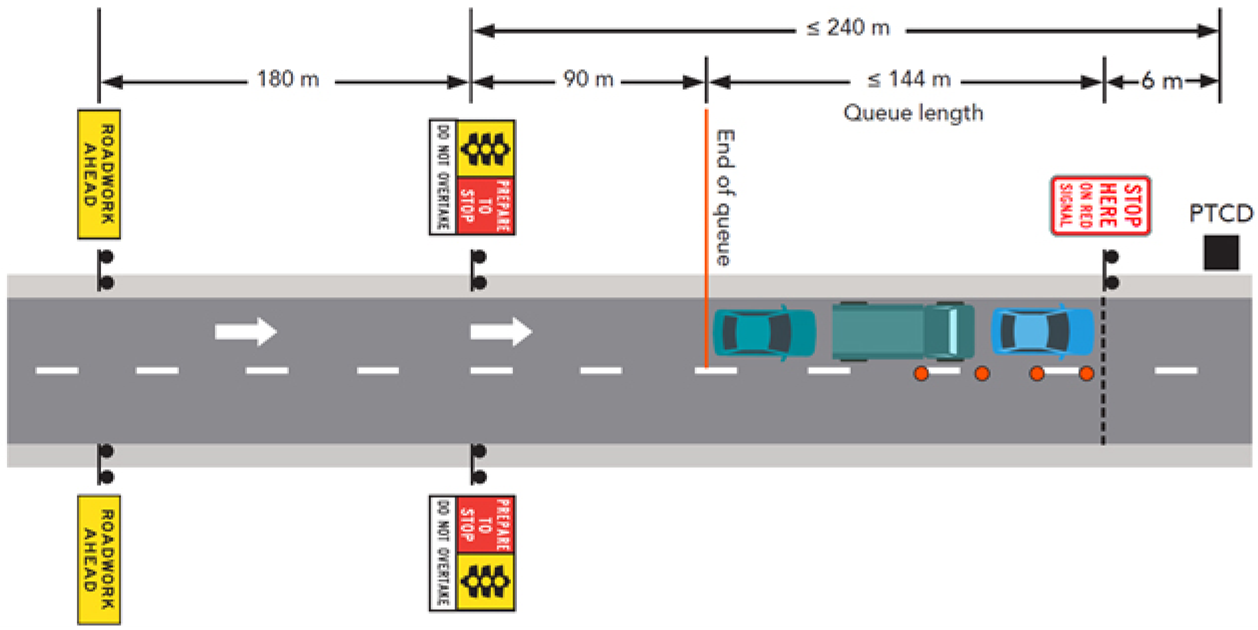


Figure 4.5 illustrates an example of sign positioning for queues as per steps above for a speed of 60 km/h where the primary PREPARE TO STOP sign is more than 240 m, but less than or equal to 300 m away from the PTCD/traffic controller. This diagram is not an example of how to install all traffic control devices and is not to be used as a TGS diagram.

Figure 4.5: Avoiding end of queue collisions (241 m to 300 m)

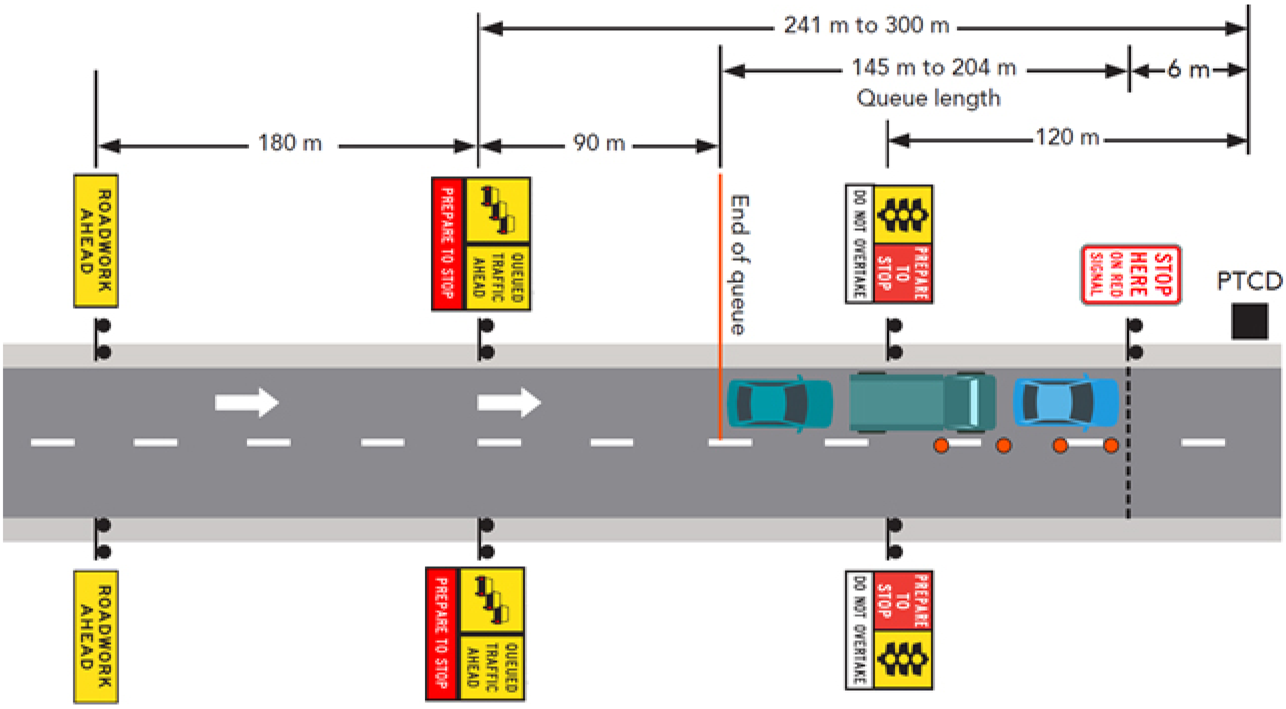
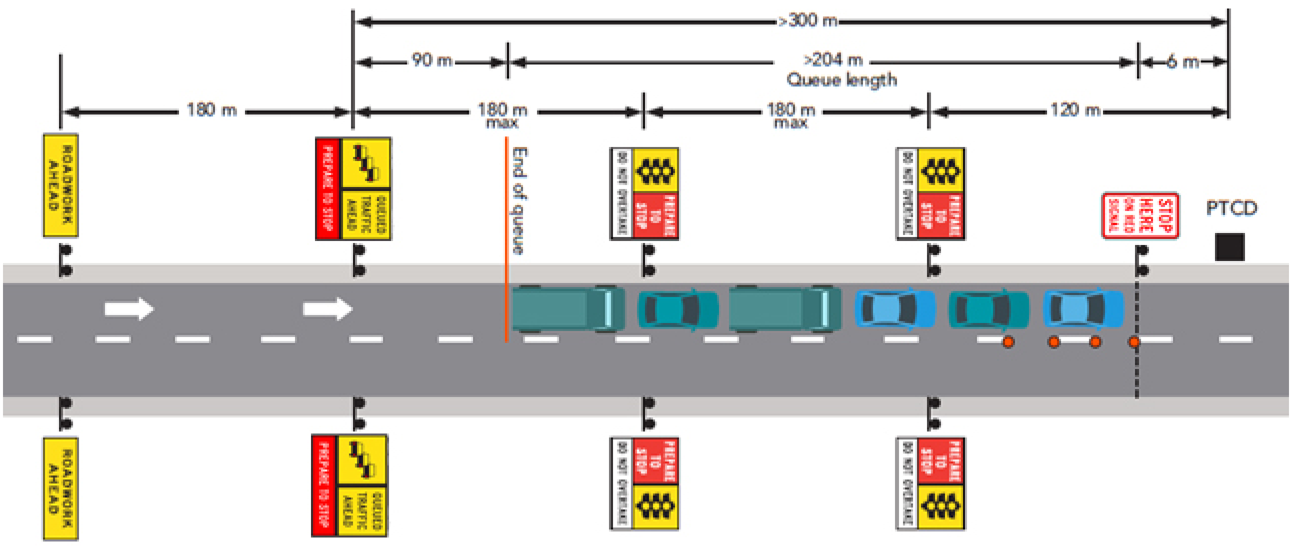


Figure 4.6 illustrates an example of sign positioning for queues as per steps above for a speed of 60 km/h where the primary PREPARE TO STOP sign is more 300 m away from the PTCD/traffic controller. This diagram is not an example of how to install all traffic control devices and is not to be used as a TGS diagram.

Figure 4.6: Avoiding end of queue collisions (> 300 m)



4.9 Termination Area

The termination area is located at the end of a worksite (see Figure 4.2) and provides information to road users indicating the end of roadwork or temporary hazard and the resumption of normal traffic conditions. An END ROADWORK sign must be installed in the termination area whenever there is a ROADWORK AHEAD or ROADWORK NEXT X km sign.

Two-way roads require termination signs for outgoing traffic and advance warning signs for incoming traffic as the termination and advance warning areas are shared by road users travelling in opposite directions.

When terminating a temporary speed zone, Speed Restriction or END Speed Limit signs must be used. If this is required at two-way roads, the termination area speed limit stays in line with the speed reduction in the opposite direction for road users approaching the worksite (see Section 5.5.1). Speeds should increase after this zone. The END ROADWORK sign should not be located prior to reinstating of speed (speed increase).

Termination signs should be placed a distance (see Table 4.5) downstream from the last point on the road or verge affected by the worksite. The placement of these signs must be based on a completed risk assessment which considers the driver's behaviour and driver compliance. Consideration of the appropriate distance is important based on the following:

- If the termination sign is placed too far from the worksite, driver compliance with signs may reduce. Where only some drivers choose to comply, an additional risk of differential speeds of drivers in this zone may cause increased risk.
- If the termination sign is placed too close to the worksite, drivers may start to accelerate too close to the worksite, placing workers and other road users at risk.

These distances in Table 4.5 may be adjusted following the completion of a documented risk assessment or to avoid creating an offset speed zone.

Table 4.5: Placement of termination signs

Speed (km/h)	Distance (m)
≤ 55	15
56 - 65	45
≥ 66	Equal to the speed (km/h)

4.10 Vulnerable Road Users

Vulnerable road users include pedestrians, on-road cyclists, off-road cyclists and motorcyclists. Works that impact the road, road shoulder, bike lanes, crossings or pathways are likely to impact on these users. Where works affect vulnerable road users, TTM measures include:

- Road features that are hazardous to motorcyclists and on road cyclists should be treated. This may include transverse and longitudinal changes in pavement level, changes in surface condition and hazards on the road.
- Pedestrian and cyclists should not be led into direct conflict with the worksite or traffic moving around the worksite.
- Where pedestrians and cyclists are diverted onto an existing roadway, the new path must be separated from vehicular traffic by an appropriate traffic control method (e.g. delineation, barriers, warning signs).
- Cyclists may be directed into lanes carrying traffic if the traffic conditions are suitable for mixed traffic.
- Safe and obstruction free temporary paths must be provided where footpaths, bicycle lanes and/or roads used by public transport are blocked by the work.

- Pedestrian and bicycle paths should where possible, be provided on the same scale and to the same width as any facilities for pedestrian or bicycle traffic that existed prior to the works. If this cannot be achieved, ensure the safe movement of pedestrians, on-road and off-road cyclists through the area is provided to separate vulnerable road users from traffic.
- The diversion of pedestrians and cyclists must consider all appropriate clearances. This includes width and height.
- Shared zones need consideration and where possible, pedestrians should be excluded from the worksite completely.
- Pedestrians with impaired vision, mobility, hearing or cognitive limitations will be considered as part of the design, preparation, approval and implementation of TTM.

4.10.1 Pedestrians

Pedestrians, particularly school children, the elderly, vision, mobility, hearing impaired or people with cognitive limitations are vulnerable road users. Their safety at or adjacent to roadwork sites is an important consideration when planning for roadworks. Where footpaths or shared paths are impacted by roadworks, alternative facilities must be provided such as:

- footpaths
- pedestrian crossings
- crossing points
- refuges.

Whenever possible, design works so that existing pedestrian facilities are not impacted. It is acknowledged however that this is not always possible and alternate provisions need to be made. The following apply when designing pedestrian facilities:

- If permanent pedestrian controls (e.g. signals, signs) are not in place, a traffic controller should be used to safely direct pedestrians to appropriate crossing points and assist with crossing the road.
- Desirably, if footpaths or pedestrian crossings have been partially closed or temporarily relocated, a temporary footpath should be provided with minimum width of 1.8 m to allow for all pedestrians including those with mobility aids or on the same scale and to the same width as any facilities for pedestrian that existed prior to the works. This width should also be applied to any temporary ramps (e.g. kerb ramps). If these widths are not practicable, alternative routes must be provided with a firm smooth surface and no trip hazards in the following order of preference:
  1. on the side of a road reserve away from traffic
  2. between the work area and road but not in a traffic lane
  3. onto the road either in a lane used for parking or a delineated and protected section of an existing traffic lane
  4. across the road to a footpath on the opposite side with delineation at crossing points and kerb ramps. Consideration is required for persons with impaired vision, mobility, hearing or cognitive limitations. Only use this option if an appropriate crossing facility can be provided (see Austroads Pedestrian Facility Selection Tool).
  5. a traffic controller to safely guide pedestrians around the operation. Only use this option if there is no safe temporary path available.
- Appropriate surfacing must be provided for prams, strollers, wheelchairs or any other mobility aids.
- Temporary paths must be illuminated at night to the level of lighting previously available on the original footpath or crossing, or as referenced in AS 1158.4, whichever is the lesser level.

- Containment fences or longitudinal channelising devices should be installed at unattended worksites or where pedestrians may gain access.
- If falling debris is a risk and there is no alternative footpath available, a structure may need to be provided to protect pedestrians and a traffic controller provided to guide pedestrians safely past the hazard.
- Temporary crossings must be provided as near as practicable to pedestrian routes with the same level of functionality as the crossings they replace. This includes signals and provisions for people with vision, mobility, hearing or cognitive limitations.
- If a temporary crossing becomes unusable or the pavement markings are obliterated, cover any remaining indication of the crossing and install barricades/safety fences on both sides of the road to prevent access to the crossing. An alternative crossing system must be provided instead.
- If the roadway is converted from one-way to two-way and pedestrian crossings are required, note the following:
  - Containment fences (see Section 5.3.2) and pedestrian mazes should be considered to restrict where pedestrians cross the road. Ensure that containment fences do not put pedestrians at risk by impacting on visibility between vehicles and pedestrians, including children.
  - Traffic controllers may be required to provide guidance at pedestrian crossings.
  - LOOK BOTH WAYS, TWO-WAY TRAFFIC signs should be placed facing approaching pedestrians on both sides of the crossing
  - The crossing must be limited to a maximum of two lanes. If this is not practicable, provide a central refuge for pedestrians (see Section 3.8.3, Figure 3.9).
- Where pedestrians have been diverted onto an existing roadway:
  - The pedestrian path must be separated from other traffic with plastic mesh fencing (see Section 5.3.2); and
  - A minimum clearance of 1.2 m should be provided from the plastic mesh fencing to the nearest traffic lane for speeds up to 60 km/h. If this clearance is not practicable, the speed must not exceed a maximum of 40 km/h. If a temporary speed limit is required see Section 5.5.1; or
  - If speed is 70 km/h or more, a road safety barrier system must be used instead of the plastic mesh fencing. Pedestrians must be clear of the deflection zone behind road safety barriers.

For detailed guidance on pedestrian paths see Austroads Guide to Road Design Part 6A.

For detailed guidance on traffic control devices for pedestrian control see AS1742.3.

4.10.2 Cyclists

Cyclists are vulnerable road users. Their safety at or adjacent to roadwork sites is an important consideration when planning for roadworks. Where shared roads, paths or bicycle paths are impacted by roadworks, it is necessary to provide alternate facilities. If a bicycle path exists that will be impacted by roadworks, the preferred approach is to maintain an alternative path not on a shared road. Note the following when designing facilities for cyclists:

- Are cyclists currently sharing traffic lanes, using bike lanes or shoulders, or riding on pathways?
- Relevant warning signs should be used to warn cyclists of any changes.
- If the existing bicycle path is on-road and affected by works, a temporary bicycle path should be provided elsewhere to a similar standard.
- Alternative paths off-road are desirable.

- If there is insufficient width for a temporary bicycle path (same width as the existing bicycle lane), merge cyclists into an existing traffic lane or shoulder. This will include:
  - appropriate approval as required by the Road Infrastructure Manager
  - delineation (see Section 5.4)
  - additional signage should be placed to alert road users of merging cyclists. This signage must be placed at the relevant stopping distance in advance of the closed section of the bicycle lane.
  - consideration of differing speeds and behaviours between cyclists and other road users. Cyclists tend to move slower and in a different manner to other road users.
  - separating cyclists from other road users by time, if the existing traffic lane is narrow or rough, by allowing other road users to manoeuvre past the worksite first and cyclists second. Traffic controllers must be provided to ensure that no other road users follow behind cyclists until they have cleared the area. Multiple traffic controllers will be required, one for traffic and one for cyclists.
  - a temporary speed limit for road users should be applied to provide safe entry of cyclists into traffic lanes.

4.10.3 Motorcyclists

Although motorcyclists are a part of traffic flow on the roadway, they are considered vulnerable road users. Issues to consider regarding the impact of works on motorcyclists and their safety include:

- Has the location of traffic control devices that might destabilise a motorcycle been avoided on their travel path?
- Is there sufficient clearance of obstructions (e.g. signs, delineation) so that motorcyclists can lean into curves?
- Is the advance warning and delineation adequate for motorcyclists?
- Is the road surface safe for motorcyclists?

4.11 Public transport

The following issues to consider, in conjunction with a risk assessment and TMP, will assist with mitigating the impacts of works on different modes of transport, connections and users.

- Have the needs for public transport been considered, adequately signed and catered for?
- Have the needs of public transport users been considered?
- Have the manoeuvring needs of public transport vehicles been considered?
- Have bus stops been well positioned for safety?

Where activities impact public transport facilities, consider the following:

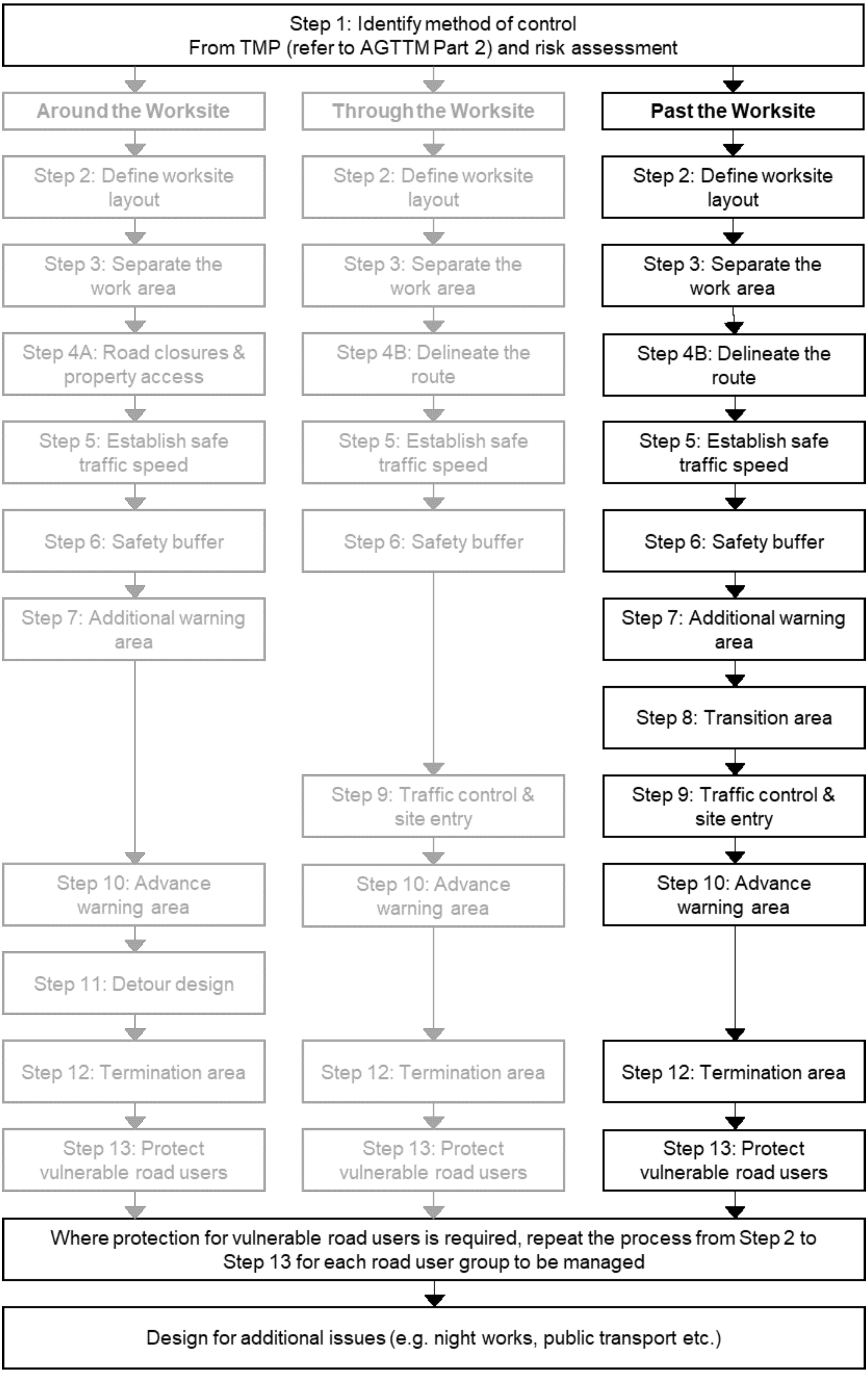
- Approval must be obtained from the relevant public transport authority to conduct works around tram lines and/or bus stops.
- Bus stops should be relocated to a temporary position if required.
- Detours should be provided for bus services if required. Detours must have an acceptable swept path and turning circle for buses.
- Safe passenger access to and from bus and tram stops must be provided.
- Appropriate warning to public transport passengers and road users should be provided by use of warning signs, delineation and/or barriers.

5. Past the Worksite

5.1 General

Design for TTM 'past' the worksite involves methods of hazard separation, when the entire work area (including all vehicles and plant) is located within 6 m from the nearest edge of a traffic lane. Due to the closeness of works and traffic, road users require more complex traffic controls to ensure both their safety and that of road workers. This is achieved through a combination of lateral separation, clear warning and delineation. Figure 5.1 details the design steps for traffic management past the worksite. For works located 6 m or clearer of traffic, consider traffic management methods around the worksite (see Section 3).

Figure 5.1: Design steps for past the worksite methods

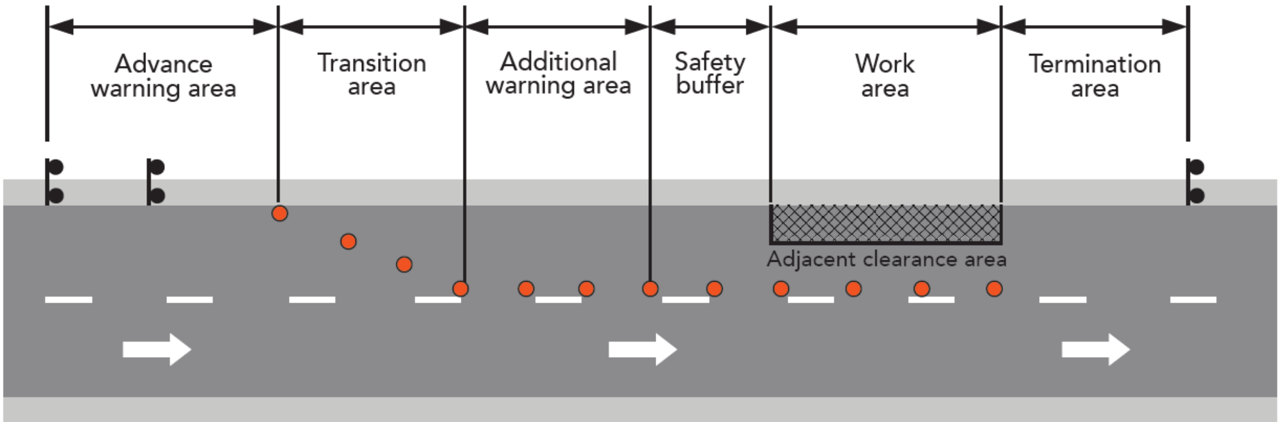


5.2 Worksite Layout

Design the work area to allow for movement of road workers, equipment, materials and vehicles, including sufficient waiting and storage space for TTM components. Ensure that the size and position of the work area enables the worksite to be managed effectively for the safety of road workers and road users. The size and position may not be consistent for the whole duration of work depending on changes in project tasks or location. This is to be considered when preparing a TGS, with appropriate risk assessment.

Figure 5.2 illustrates the concept of zoning within a typical worksite that uses 'past' traffic management methods for road users approaching from the left and moving to the right as shown by the arrows. This diagram is not an example of how to install traffic control devices and is not to be used as a TGS diagram.

Figure 5.2: Typical Layout for Past the Worksite



5.3 Separate the Work Area

Separating the work area by providing a physical or visual barrier reduces the risk of incidents between vehicles, road workers and vulnerable road users. Treatments are also designed to reduce the potential for unwanted intrusion into the work area. Options include:

- road safety barrier systems
- containment fences
- visibility screens
- lateral separations.

5.3.1 Road safety barrier system

The road safety barrier system provides a physical barrier between the work area and moving traffic, designed to resist intrusion by errant vehicles and as far as practicable, redirect errant vehicles back into the travelled path. While safety barriers can be considered for all projects, this method may be inappropriate due to physical space requirements and limited edge clearances. If a road safety barrier is to be used, its design must be based on the posted speed outside of works and not for the posted speed during works.

Safety barriers are typically used to:

- separate road users from severe hazard (e.g. deep excavation, a bridge pier, stockpile)
- separate traffic travelling in opposite directions
- reduce delays by avoiding more restrictive speed limits

- protect road workers and vulnerable road users (e.g. road shoulder as a temporary footpath) from narrow lateral clearance to moving traffic (e.g. when the work area is closer than 3 m to the nearest edge of traffic and the speed limit is more than 60 km/h). For work areas located more than 6 m to the nearest edge of traffic see Section 3: Around the Worksite.

End treatments must be provided when installing road safety barrier systems, ensuring they are immediately operational as part of the barrier system. They are designed to absorb energy and reduce the severity of impacts, also assisting in reducing the risk of errant vehicles entering the work area and road users accidentally impacting the barrier. End treatment options include:

- flaring the barrier system away from the road when the end of a barrier is further away from a traffic lane. Barrier design will provide guidance on the rate of flare.
- starting or connecting the barrier to the end of a permanent barrier or guardrail
- securely attaching any approved end treatment as per the Austroads Guide to Road Design Part 6 (e.g. crash cushions).

The Austroads Safety Barrier Assessment Panel (ASBAP) expects products to conform to AS/NZS 3845. However, if a jurisdiction wants to deploy a product that has not been assessed by ASBAP, the jurisdiction will undertake its own risk assessment.

End treatments are not required if the temporary road safety barrier system is flared behind a permanent road safety barrier or is outside of the adjacent clearance area and therefore not regarded as a hazard.

The following elements apply when positioning road safety barrier systems:

- Adequate delineation of the road safety system must be provided to ensure road users are safely guided past the worksite.
- Fittings other than delineators (e.g. visibility screens) must not be fixed to the road safety barrier unless they are designed to accommodate the fitting.
- Screens designed to fit to barriers should also be approved by the relevant road authority relative to the work being done.
- Water runoff should pass unimpeded to avoid surface ponding.
- If positioned near high obstructions (e.g. power poles, fixed VMS, bridge piers, underpass scaffolding), the design should consider the extent of vehicle body roll (especially high vehicles) during impact.
- Barrier deflection must be accommodated in the area immediately behind the road safety barrier system. A containment fence or longitudinal channelising barrier should be placed a clear distance equal to the likely dynamic deflection behind the road safety barrier system. Clearance in Table 5.1 is measured between traffic and the front of the barrier system and not behind the barrier system in the deflection zone. For example, see Figure 5.4 illustrating dynamic deflection. This example does not include all traffic control devices required and must not be used as a TGS diagram.
- A clearance between the road safety barrier system and the edge of the nearest traffic lane must be provided as shown in Table 5.1. These clearances are a recommendation only. There are no minimum clearances for permanent road safety barriers so the minimum for temporary systems if equally rated should be the same. Consider that road users often increase their travel speed during times the worksite is unattended.

For further guidance regarding road safety barrier systems, see Austroads Guide to Road Design Part 6.

Figure 5.3 illustrates an example of safety barrier placement around the work area. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 5.3: Safety barrier protection of work area

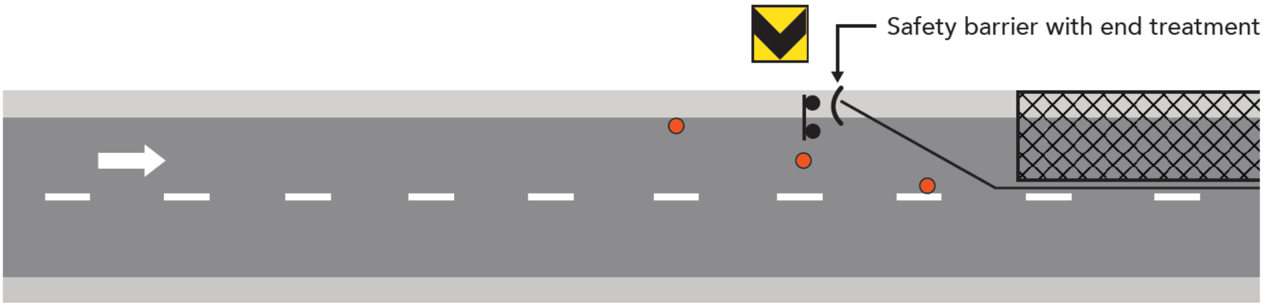


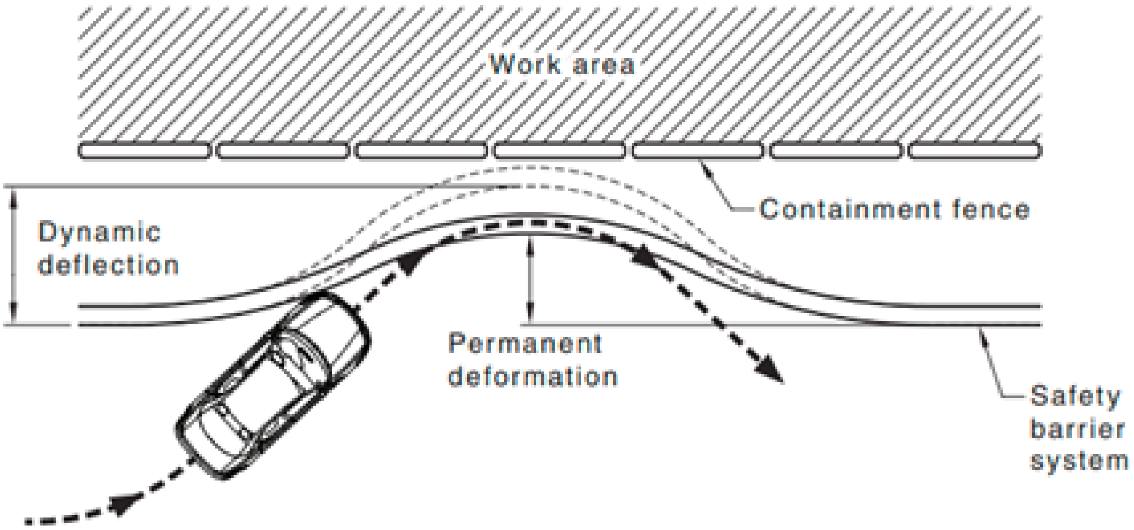
Table 5.1: Road Safety Barrier System Clearance to Traffic Lane

Speed (km/h)	Distance (m)*
≤ 40	0.3
41 - 60	0.5
61 - 80	1
> 80	2

**Clearance is measured in front of the barrier system and not behind the barrier system in the deflection zone.*

Figure 5.4 illustrates an example of dynamic deflection. Clearance in Table 5.1 is measured in front of the barrier system and not behind the barrier system in the deflection zone. This example does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 5.4: Dynamic deflection and protective fencing behind a safety barrier system



5.3.2 Containment fence

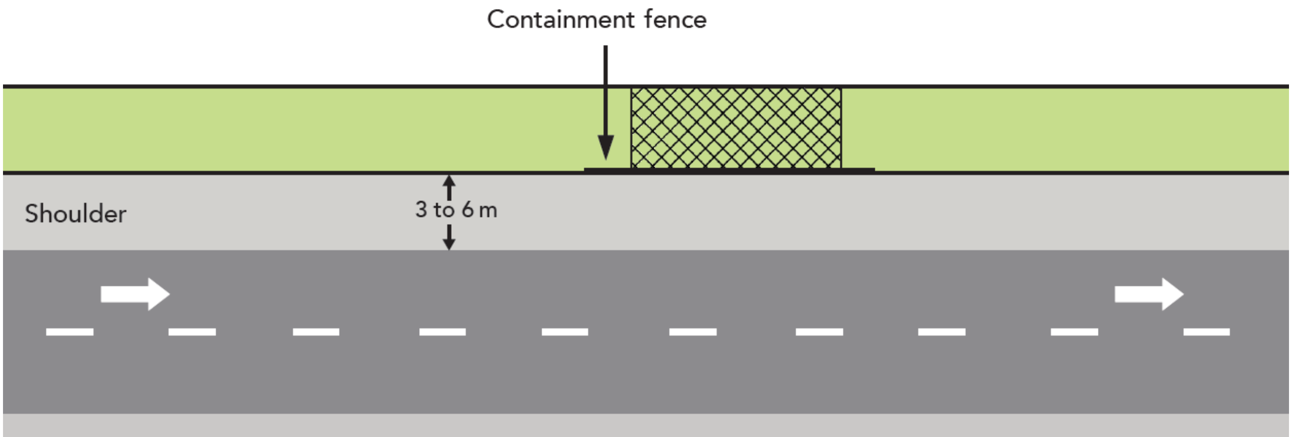
Containment fences are used to keep road workers or pedestrians within a defined area, safely away from traffic. This method is typically used when physical protection is not required (e.g. the work area is more than 3 m clear to the nearest edge of traffic and speeds are 60 km/h or less, or, works greater than 6 m from traffic with no speed restriction) but are used to:

- define a no-go-zone behind a road safety barrier
- keep workers a safe distance from traffic
- keep pedestrians in a defined area away from works and traffic.

Containment fences must not be used as safety barriers or to act as delineation when used adjacent to traffic.

Figure 5.5 illustrates an example of 'past' methods with clearance of more than 3 m up to 6 m. For clearance of more than 6 m see Section 3: Around the Worksite.

Figure 5.5: Work area 3 to 6 m clear of moving traffic



Ensure that the containment fence has sufficient stability to resist displacement, fracture or deflection of more than 0.5 m that may arise from strong winds or air turbulence from passing traffic. Where containment fences are used adjacent to traffic, provide delineation (e.g. traffic cones) between traffic and the containment fence.

Containment fence options include:

- Tapes:
  - may be used to contain workers on foot and plant within the work area boundary
  - must not be used as delineation between traffic and containment fence
  - must not be used for pedestrian containment adjacent to traffic
  - must be a minimum 100 mm wide with stripes of alternate, contrasting colour
  - must be installed so that tape is supported 1 m above ground.
- Plastic mesh fencing:
  - may be used for pedestrian containment and/or containing workers on foot and plant within the work area boundary
  - must be installed so that the top of the fence is 1 m above ground.

- Longitudinal channelising devices:
  - may be used for pedestrian containment and/or containing workers on foot and plant within the work area boundary
  - must comprise interconnected modules only
  - must be marked with letters stating 'NOT A SAFETY BARRIER'
  - must provide clearance to the edge of the nearest traffic as shown in Table 5.2.

Note that metal star pickets should not be used in situations where they are directly exposed to traffic or any environment where they may be hit by a vehicle.

5.3.3 Visibility screens

Visibility screens are an anti-gawk device between the work area and moving traffic and may also be a hazard interception device. This method is typically used to simplify road conditions, in turn reducing the risk of road users becoming distracted by the worksite. As at the date of publication of this guide, there is currently no test for approval of visibility screens. However, the following provides guidance for designers proposing to use a visibility screen.

Note the following when installing visibility screens:

- Provide a continuous screen at a minimum of 2 m in height above ground.
- Any visibility screen should only be used if it will not create an additional hazard and will not become a hazard if struck by a vehicle. This includes not attaching to the front face of a road safety barrier system. Position to be free standing behind barriers outside of the deflection zone (see Figure 5.4). Do not attach to the barrier with mechanical fixings (e.g. pipe clamp, bolted joints).
- Ensure that visibility screens do not impact the performance of the road safety barrier system.
- Accommodate passing wide loads and over-dimensional road users.
- Clear sight distance to signs. Remove one or more screens where required so that signs are visible to road users.
- Visibility screens may impact sight distance requirements especially when the alignment is curved.
- Visibility screens may attract graffiti and become a visual distraction, so should be monitored for graffiti and have graffiti removed.

5.4 Delineate the Route

For situations where it is safe for traffic to travel past the worksite, delineation is provided to ensure safety of road workers and road users whilst providing a clear pathway of travel. Delineation devices include:

- traffic cones
- bollards
- temporary hazard markers
- post-mounted reflectors
- temporary kerbing
- temporary line marking
- raised reflective delineating devices
- temporary lighting (if required for night works)
- longitudinal channelising barricades
- barrier boards.

Steel drums must not be used as a delineation device.

If the travel path past the worksite deviates substantially from the normal route, pre-works delineation should include a task to remove pavement markings and raised delineating devices that could misdirect road users.

The clearance between delineation and the edge of the nearest traffic lane should be as shown in Table 5.2. Delineation must remain in place, upright and effective for the duration of the works and should not have to be attended to regularly. Where being regularly dislodged (e.g. due to passage of heavy vehicles) these offsets may need to be increased.

Measure from the traffic-side edge of the delineating device or barricade.

Table 5.2: 'Past' edge clearance

Speed (km/h)	Distance (m)
For traffic cones, bollards, longitudinal channelising barricades or any other delineation device	
≤ 65	0.3*
≥ 66	0.5
For post-mounted reflectors, temporary hazard markers	
All speeds	1
For kerbed edges of traffic lanes	
All speeds	0.3 - 0.5 (behind the face of kerb)
For delineation adjacent to excavations see Section 6.8 Table 6.1	
For plastic mesh fencing (e.g. temporary pedestrian pathways) see Section 5.3.2	

** Use this distance when delineating the path. If devices are being used to reduce speeds, as with traffic cones, the offset distance can be reduced to 0 m.*

If narrower edge clearance is required, obtain approval from the relevant road infrastructure manager.

If delineation devices are used to separate road users from rigid objects (e.g. concrete barriers, parked plant), a Temporary Hazard marker must be placed beside the first rigid device, pointing to the side of the object which is appropriate for road users to pass. Repeated temporary hazard markers must be spaced so they appear as a continuous line to approaching road users. If other signs are used in conjunction with temporary hazard markers, these signs must be placed to appear above, not amongst, the line of temporary hazard markers.

The spacing between delineation devices should be as detailed in Table 5.3.

These are maximum measurements and can be reduced (e.g. on curves, at night). If there is a risk that road users may take a wrong turn or take the wrong path, spacing may be reduced to 1 m.

Table 5.3: 'Past' spacing of traffic cones, bollards and post-mounted delineators

Purpose and usage	Speed limit (km/h)*	Recommended maximum spacing (m)
For traffic cones and bollards**		
All purposes	≤55	4
	56 - 75	12
	≥76	18
Protecting freshly painted lines	56 - 75	24
	≥76	60
Centreline on approach to a traffic controller position	All speeds	4
Crossover for contraflow (e.g. through the median)	All speeds	2
Taper at traffic control station	All speeds	4
For post-mounted delineators		
All purposes	≤75	24
	≥76	60

**Use the speed limit where the cones and bollards are installed*
***Consider whether cyclists are using the road shoulder or bike lane and whether an appropriate alternative facility be provided before installing traffic cones or bollards in the area. Where possible, place bollards to maintain a safe cycling facility.*

If there is a risk that workers or small plant items will infringe into the clearance area, a containment fence should be installed as additional delineation on the edge of the work area (see Section 5.3.2).

5.4.1 Traffic cones and bollards

When installing traffic cones and bollards the following apply:

- Maximum spacing of cones and bollards must be as shown in Table 5.3.
- If there is a risk that road users will take a wrong turn or take the wrong path spacing may be reduced to as little as 1 m.
- Traffic cones and bollards must be fitted with retroreflective bands.
- Traffic cones and bollards must be stable to reduce the risk of displacement from strong winds, air turbulence from passing traffic or minor impact, especially when road workers are not present.
- Traffic cones and bollards must be securely fixed or weighed down when road workers are not present on site.
- Various cone sizes available should be used as follows:
  - Small traffic cones (450-500 mm high) in built-up areas and open roads including footpaths, shared paths and bicycle paths where traffic speeds isdo not exceed 60 km/h
  - Standard traffic cones (700 mm high) all other road applications where traffic speeds exceed 60 km/h. Standard size cones may be used on lower speed roads.
  - Large size cones (900 mm high) may be used instead of standard cones on high speed, high volume roads (e.g. expressway type roads)
- Offset traffic cones where shifts, merges or other changes in direction occur. This allows vehicles (especially heavy or over-dimensional) to manoeuvre through the taper without impacting the delineation.

For details on device requirements see AS1742.3.

Figure 5.6 illustrates an example of offset traffic cones. Note that it is the cones highlighted in yellow that are offset by 10 m and that the right-hand lane has been closed in front of the area visible in this diagram. The intent of this diagram is to show the offset of traffic cones only. It does not take into consideration the entry and exit of vehicles as lateral shifts are not a requirement upon departure. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 5.6: Example of Offset traffic cones

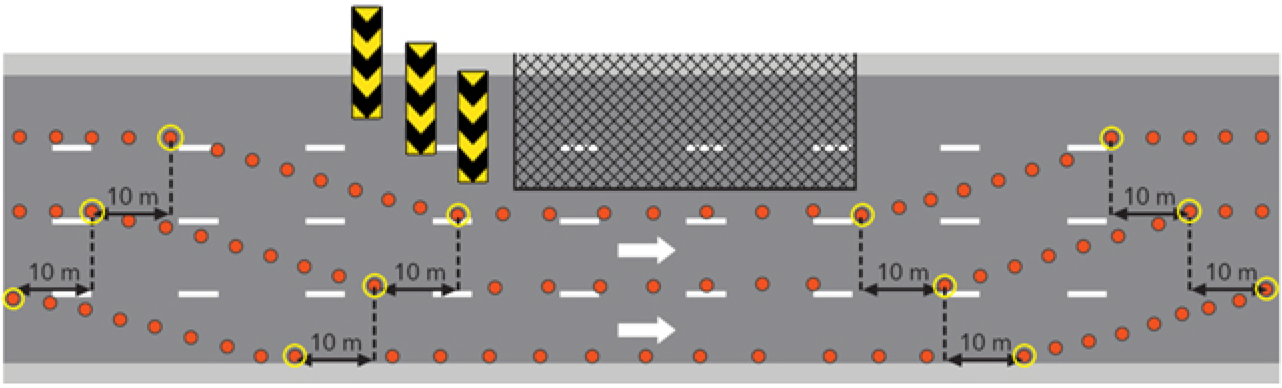
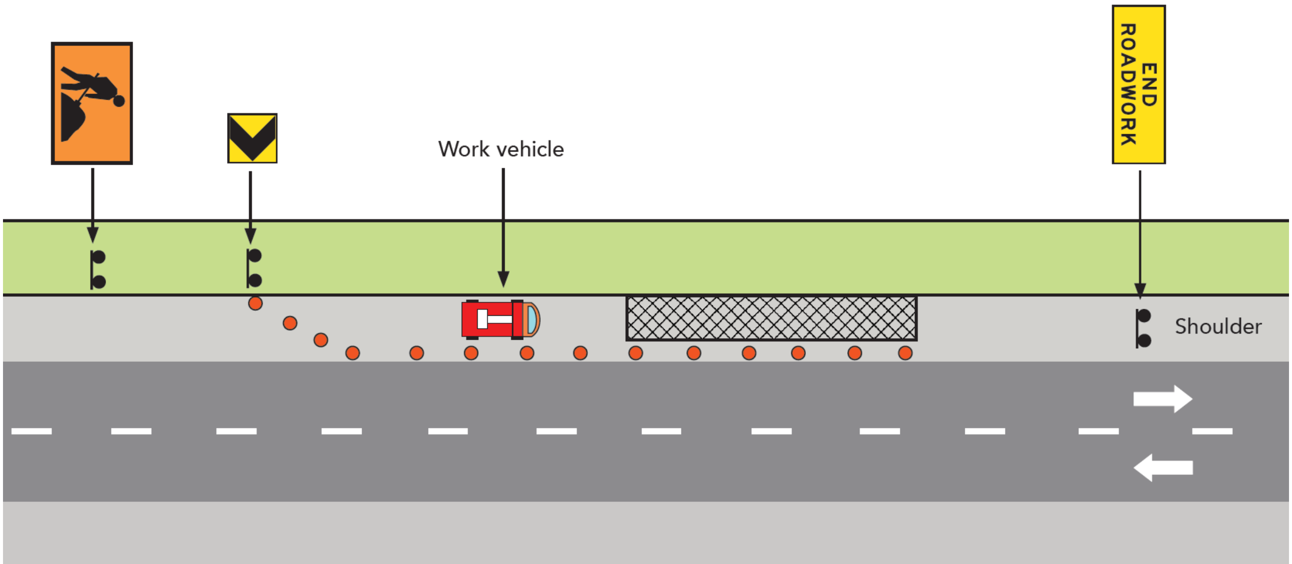


Figure 5.7 illustrates an example of delineation for works in a shoulder. Note that the hatched work area is 1.2 m clear of the traffic lane. A safe route for cyclists has not been covered in this diagram and should be planned for (see AGTTM Part 2) if required. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 5.7: Delineation for works in a shoulder



5.4.2 Temporary hazard markers

This device is typically used:

- in combination with a delineation device
- should generally be 1 m clear from the edge of the traffic lane where cyclists are not expected to be using the shoulder. If cyclists are expected to be using the shoulder, the device should be installed where possible on the verge and a cycle lane with 1.2 m minimum area defined around the hazard.

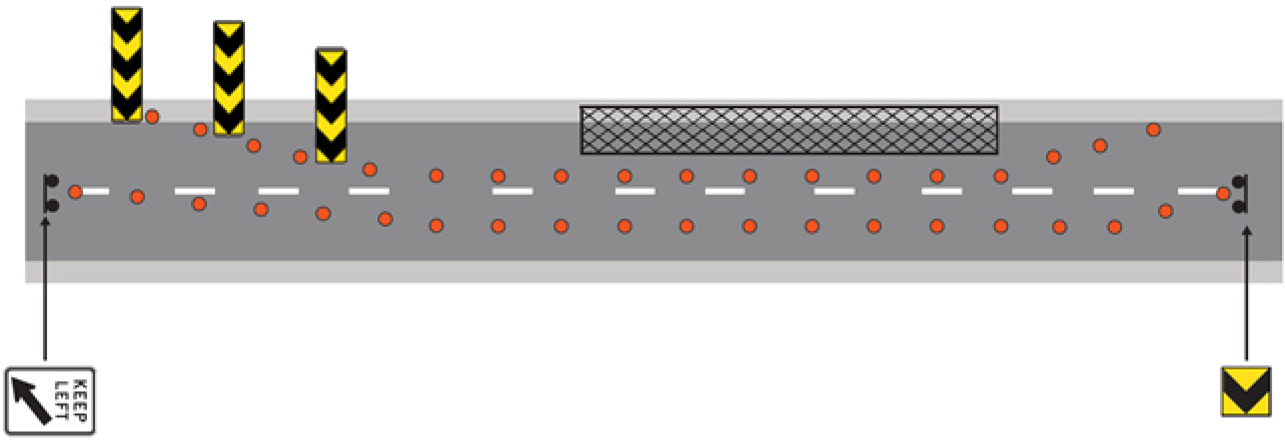
- to indicate a lateral change of direction on the travelled path (e.g. at the start of a traffic cone/bollard delineation path, taper)
- to delineate hazards (e.g. obstruction encroaching onto the roadway)
- to delineate non-trafficable areas adjacent to the travelled path.

When installing temporary hazard markers, the following are requirements and recommendations:

- Markers must be placed beside the hazard or delineation device, pointing to the side of hazard which is appropriate for road users to pass.
- Repeated markers must be spaced so they appear as a continuous line to approaching road users.
- If other signs are used in conjunction with markers, these signs must be placed to appear above, not amongst, the line of temporary hazard markers.
- Markers should be placed 1 m clear from the edge of the travelled path.
- If delineation is needed on both sides of a taper, markers should be placed on the side primarily steering traffic away from the obstruction. Use traffic cones, bollards or post mounted reflectors on the other side of the taper. This will reduce confusion amongst road users which may be created by placing hazard markers on both sides of a lane.

Figure 5.8: illustrates an example of using temporary hazard markers. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 5.8: Temporary hazard markers



For details on device requirements see AS 1742.3.

5.4.3 Temporary kerbing

This method is typically used to form temporary medians, traffic islands or pavement edges.

When using temporary kerbing the following are requirements:

- must be securely fixed to the pavement to avoid movement
- height must be no more than 150 mm maximum
- must be yellow in colour
- must clearly delineate to appear as a continuous line at least 150 mm wide to approaching road users.

For details on device requirements see AS 1742.3.

5.4.4 Shuttle flow

This method is typically used when a portion of the roadway is closed so that a single lane is used alternately by traffic travelling in opposite directions. It is one-way flow with one direction first, then the other.

When using shuttle flow the following are requirements and recommendations:

- Lane width should be reduced in accordance with Table 2.5. For further guidance on lane widths see Section 2.5.8.
- The swept path must accommodate heavy and over-dimensional vehicles if required.
- Traffic control must be provided at each end of the operation (see Section 5.10). Traffic control may not be required if:
  - there is clear visibility past the work area and beyond it for at least 75 m, or to the end of the road if less than 75 m away and the length of the shuttle lane does not exceed 60 m
  - road users have clear visibility of the work area and the opposing approach for a distance greater than 150 m and either one of the following:
    - traffic volume in both directions is 40 vph or less, and the speed is 70 km/h or less, and the length of the single lane is 60 m or less
    - the length of the single lane is 100 m or less, and GIVE WAY and ONE LANE signs are provided at one end of the shuttle lane
    - it is a residential street and the length of the shuttle is 60 m or less.
- Ensure single lane section lengths are a maximum distance as shown in Table 5.4.

Table 5.4: Maximum length of operation under shuttle flow

Traffic volume in both directions (vph)	Length of single lane section (m)
Residential street	60
701 - 800	70
601 - 700	100
501 - 600	150
401 - 500	250
351 – 400	400
301 – 350	600
≤ 300	800

5.5 Safe Traffic Speed

The management of speeds chosen by road users is a crucial contributor to a safe worksite. Prior to undertaking work on any site, it is important to ensure:

- the speed limit enforced on road users is correct
- the speed limit is checked prior to starting work
- the speed of road users is monitored for the whole worksite.

The chance of a crash is reduced at lower traffic speeds because the road user has more time for decision making, is less likely to lose control, and has the ability to take action that will result in the vehicle stopping quicker. At lower speeds, if there is a collision, there is less impact involved, reducing the risk of severe injury. Treatment options to reduce traffic speeds include:

- temporary speed limits (see Section 5.5.1)
  Note temporary speed zones at worksites are required to meet certain workplace safety requirements, including the protection of traffic controllers and workers on foot.
- narrowing lane widths (see Section 2.5.8)
- temporary speed humps (see Section 5.5.2)
- flashing lamps, flares or illuminated signs
- close spacing of delineation devices (see Section 5.4)
- road safety barriers (see Section 5.3.1) or fences along traffic lanes
- visibility screens (see Section 5.3.3)
- tapers (see Section 5.9.1). If tapers are used, place traffic cones on the edge line or shoulder from the start of the temporary speed zone to the taper.
- offsetting traffic cones by placing them on both sides of a lane, but traffic cones on one side are offset from traffic cones on the other side by half a cone spacing
- traffic control (e.g. PTCD, traffic controllers) (see Section 5.10)
- enforcement, subject to road policing priorities and availability. Enforcement should not be relied upon as a key element of design.

Use a combination of the above treatments when road users are not following temporary speed limit signs and safety is compromised.

Consider the following:

- the risks associated with road workers (especially traffic controllers) and road users, including vulnerable road users
- sight distance to the worksite
- edge clearances and lane width
- the frequency of conflicts or hazards at the site
- traffic flow and delay reduction
- road geometry and characteristics
- Will vulnerable road users (see Section 5.13), including on-road cyclists, be separated from other traffic or does the design rely on creating a safe, low speed mixed traffic environment?
- Worksite and road worker safety requirements take precedence (if lower) over speeds for traffic safety when deciding on a speed limit.

5.5.1 Temporary speed limits

Temporary speed limits can be used to regulate the speed of traffic due to roadworks, temporary hazards, emergencies or special events. Authorisation from the relevant road infrastructure manager needs to be obtained prior to works commencing, normally during the planning stage (TMP phase). Details of the temporary speed limit, approximate length of the temporary speed zone (e.g. temporary speed limit of 60 km/h for 150 m) and associated roadwork signing is submitted with the TMP. If alternative means of traffic control are adequate, there is no need to implement additional temporary speed zones.

Temporary speed limits are implemented for workplace safety and traffic safety requirements to protect workers from oncoming or passing traffic and road users from hazards within the static work site. To meet specified safe workplace requirements, including the protection of traffic controllers, reduction in traffic speeds to either 80 km/h, 60 km/h or 40 km/h must be required.

If the specified temporary speed limit is lower for site workplace safety requirements than traffic safety requirements, the temporary speed limit for workplace safety requirements takes precedence (e.g. high level of hazard for workers on foot in a worksite with reduced visibility – the required temporary speed limit is 40km/h or less).

Temporary speed zone conditions and lengths are outlined in Table 5.5.

The primary objective of temporary speed zones is to ensure that all workers operating in and around the work zone are safe. The secondary objective is to ensure the application of temporary speed zones are safe and convenient for road users. Sufficient warning of changes in speed limit due to surface condition and work zone layouts need to be communicated to all road users.

Where a decision has been made to create a temporary speed limit, the following apply:

- The temporary speed limit should be self-enforcing or will be enforced.
- The temporary speed limit must be realistic and reflect the condition of the worksite in real time. This will reduce the risk of road users ignoring the speed limit.
- The temporary speed limit must be obvious to all road users.
- The temporary speed limit should encourage uniform speed of travel.
- Speeds should be low enough to allow road users time to react to signs, directions, traffic control or unusual events.
- The temporary speed limit must not be so low that a significant number of road users disregard it.
- Temporary speed limits may be a compromise where conditions vary over a length of road.
- The length of the temporary speed zone should be as shown in Table 5.5.
- The speed limit applied to the zone must not exceed the maximum safe speed of travel at which traffic can safely traverse the site. The maximum safe speed of travel depends on a number of factors including:
  - number and type of vehicles
  - number of pedestrians / cyclsits
  - type of works undertaken
  - extent of the works
  - road characteristics
  - number of incidences, conflicts or hazards on the road. Where the frequency of incidents, conflicts or hazards on a road increase, the maximum safe speed of travel needs to be reviewed.

Selecting the speed limit

Selecting the temporary speed limit at works is dependent on workplace safety and traffic safety requirements. Temporary speed limits are a viable option for any of the following examples:

- shuttle flow
- contraflow
- temporary stopping

- temporary traffic signals and PTCD
- the number of lanes is reduced
- merges
- narrow lanes
- protecting traffic controllers
- visibility is restricted (e.g. dust, work equipment, construction materials, abnormal weather conditions)
- limited clearance between road workers or equipment and moving traffic
- the alignment or road surface is below standard
- loose material or stones
- works can be damaged by higher speeds
- emergencies (e.g. flooding, slips, crashes, fire)
- good technical reasons (e.g. the road might otherwise collapse).

A guide to selecting the required temporary speed zone is provided in Table 5.5.

Table 5.5: Length of temporary speed zone

Temporary speed limit (km/h)	Length of zone (m)	Conditions
< 40	100 – 200	• high level of hazard for workers on foot or road users, including pedestrians or cyclists.
40	100 (minimum) – 500 (maximum)	• workers on foot within 1.2 m of traffic with no physical barrier • structural danger to bridges. • moderate level of hazard for workers on foot or road users, including pedestrians or cyclists
60	150 (minimum)	• workers on foot between 1.2m and 3m of traffic or small plant within 3 m of traffic with no physical barrier (i.e. road safety barrier) • on approach to the traffic controller or PTCD • reduced visibility (e.g. dust or smoke) • reduced standard alignment • degraded pavement surface • newly laid bituminous seal.
80	500 (minimum)	• workers on foot or plant within 3 – 6 m of traffic with no physical barrier • disturbance to alignment or pavement surface.
80 (buffer)	300 (minimum)	• for advance warning of a 40 or 60 km/h when speed is 100 km/h or more.

Designing the speed limit

Speed limits may be reduced depending on the size of the reduction by one or a combination of the following:

- a speed limit sign
- a speed limit of intermediate value or a buffer zone
- a speed limit AHEAD sign.

Speed limit reductions must be implemented as provided in Table 5.6.

Table 5.6: Method for reducing speed limit

Speed limit reduction	Method for reducing speed limit	Recommended applications	Alternative applications
10	Speed limit sign	60 – 50 50 – 40 40 – 30	
20	Speed limit sign or Speed limit AHEAD* (alternative)	100 – 80 80 – 60 60 – 40	100 – 80 AHEAD – 80* 80 – 60 AHEAD – 60* 60 – 40 AHEAD – 40*
30	Speed limit AHEAD or Speed limit sign or Speed limit signs (alternative)	110 – 80 AHEAD – 80 110 – 80 90 – 60 AHEAD – 60 90 – 60 70 – 40 AHEAD – 40 70 – 40	110 – 100 – 80 90 – 80 – 60 70 – 60 – 40
40	Speed limit AHEAD or Speed limit signs	100 – 80 – 60 100 – 60 AHEAD – 60 80 – 60 – 40 80 – 40 AHEAD – 40	
50	Speed limit signs and/or Speed limit AHEAD	110 – 80 – 60 110 – 80 AHEAD – 80 – 60 100 – 80 – 50 100 – 80 – 50 AHEAD – 50 90 – 60 – 40 90 – 60 AHEAD – 60 – 40	110 – 80 – 60 AHEAD – 60 100 – 80 AHEAD – 80 – 50
60	Speed limit signs and/or Speed limit AHEAD	110 – 80 – 60 – 50 110 – 80 AHEAD – 80 – 50 110 – 80 – 50 AHEAD – 50 100 – 80 – 60 – 40 100 – 60 AHEAD – 60 – 40 100 – 80 – 40 AHEAD – 40	110 – 80 – 50
70	Speed limit signs and/or Speed limit AHEAD	110 – 80 – 60 – 40 110 – 80 AHEAD – 80 – 60 – 40 110 – 80 – 40 AHEAD – 40	110 – 80 – 60 – 40 AHEAD – 40* 110 – 80 – 60 AHEAD – 60 – 40*

*May be used where additional advance warning of speed limit reduction is required

Where the need for a temporary speed limit occurs part way into a worksite, the temporary speed zone must be started at that point rather than the start of the worksite. For example, the short term need to localise a speed limit and accommodate workers on foot less than 1.2 m clear of a traffic. More than one localised speed zone is permitted within one worksite if the minimum distance between them is equal to the length of zone for the higher speed limit shown in Table 5.5. Temporary speed zones that result in different speed limits for each direction of travel at a particular location (offset speed zones) may be used in the following conditions:

- on divided roads where works affect road users on one side of the median only
- on multilane undivided two-way roads that meet all of the following:
  - more than one lane in the same direction of travel past the worksite
  - works in the left lane and/or clear of the road

  - conditions necessitating the temporary speed limit are confined to one direction of travel only
  - there are no intersections or property access requirements within the temporary speed zone.
- where a speed buffer zone is provided. For example, advance warning of a 60 km/h speed limit is provided in an 80 km/h buffer zone, when the original speed was 100 km/h. This buffer zone speed limit is not needed for road users leaving the temporary speed zone because the buffer does not apply to the opposite direction of travel. The offset speed zone will only apply in the speed zone buffer area and not the whole worksite.

Temporary speed zones are communicated clearly to road users with the following traffic control devices in order for them to recognise the need to adjust their speed:

- a Speed Limit AHEAD sign is located a distance double the speed in advance of the Speed Restriction sign
- a Supplementary ROAD WORK and Speed Restriction signs at the start of temporary speed zone. Speed restriction signs are to be placed on both sides of the roadway where practicable
- a Speed Restriction sign (indicating the speed limit past the termination area) or END Speed Limit sign to terminate the temporary speed zone on both sides of the roadway where practicable. An END ROADWORK sign can be placed beyond the temporary speed zone or concurrent with a Speed Limit sign or the END Speed Limit sign on both sides of the roadway where practicable.

Repeater signs must be used to confirm and remind users of the speed limit where the zone is long and there are locations which could seem like the temporary speed limit no longer applies (e.g. between work areas in an extended worksite), or to advise road users entering the temporary speed limit. Repeater signs must be placed on the left-hand side of the road at a maximum spacing of 500 m and on both sides on multilane roads.

At the end of the temporary speed zone, the following requirements apply:

- A speed sign must be used to exit the temporary zone. When using this sign at the end of the roadworks, the ROAD WORK supplementary signs are not to be used in conjunction.
- Signs are to be placed on both sides of the carriageway where practicable.

If it is not practicable or possible to terminate the temporary speed limit beyond the temporary speed zone by the above methods, the END Speed Limit sign (R4-12) may be used. An example of this is where the default speed limit (typically on rural roads), road surface, alignment or other conditions will not allow the road user to travel safely at that speed. It is a legal requirement that a speed zone is terminated by:

- another regulatory speed control sign or END Speed Limit sign
- other means of traffic regulation imposed by the State.

Operational

The following requirements apply when installing speed signs:

- Any permanent speed signs that contradict the temporary speed limit in the required zone must be covered or removed.
- Any advisory speed signs higher than the temporary speed limit in the required zone must be covered.
- Signs must be placed on both sides of the roadway where practicable to ensure road users have clear visibility of speed limit signs.
- Temporary speed limit signs should be used together with other appropriate devices already required by other site conditions. For example, display temporary speed limit signs used for worksite protection and safety in conjunction with the Workers (symbolic) sign.
- All speed limits related to road worker safety must be removed or covered when road workers, traffic controllers or plant are not on site.

- Speed limits when road workers, traffic controllers and plant are not on site should be determined with consideration of the safe passage of road users. If no hazard to road users exists, the speed limit should be returned to the permanently posted speed limit.
- Any gantries within the worksite with Variable Speed Limit or Lane Control signs must be programmed to display the temporary speed limit or turned off. Check the TMP for guidance on other large permanent signs and variable speed limit signs.
- A record of dates and times temporary speed limits are in operation must be kept, including any changes made, the name of personnel installing, changing or removing signs (see Section 2.5.3).
- Workplace safety must be considered during set-up and dismantling of signs.

Temporary speed limits should only apply while the condition that makes them necessary exists, so remove temporary speed limit signs as soon as the necessity passes. For further details on signs see Section 2.5.3.

5.5.2 Temporary speed humps

It is recognised that some road users do not strictly observe roadwork speed limit signs, and in some cases do not respond to the directions given by traffic controllers to slow down through roadwork sites. Temporary speed humps can be used to assist with temporary speed limits when other traffic management treatments are also in place and road workers are on site.

Temporary speed humps should only to be used where all other road environment options which can be used to encourage compliance with the speed limit have been exhausted and compliance with speed continues to be an issue.

The appropriateness of the use of temporary speed humps should be considered if they become a hazard for vulnerable road users such as cyclists. Figure 5.9 shows an example of a temporary speed hump.

Figure 5.9: Temporary speed hump

Consider the following when installing a speed hump:

- use jurisdictionally approved products in accordance with relevant acceptance documents
- sight distance (see Section 2.5.3)
- temporary speed hump material and profile
- lighting

- a maximum 40 km/h speed limit must be used on approach and over the speed hump (see Section 5.5.1)
- road surface, to ensure the effectiveness of affixing the humps to the surface and their ability to stay in position
- safety of workers installing, maintaining and removing equipment
- place traffic cones on the edge of the lane and centerline from the temporary speed limit sign to the speed hump for advance warning to road users
- provide all other traffic management treatments required at the site first, then use a suitable traffic control device to protect the workers installing/removing the speed hump.

5.5.3 Rumble strips

Rumble strips are transverse strips in or on the pavement which give an audible and tactile sensation to the driver of vehicles passing over them. They can either be raised above the pavement or grooves formed in the pavement.

They are used such that the increased noise, vibration and driver discomfort associated with the speed of travelling over the strips will encourage drivers to reduce their speed. For example, installing rumble strips on the approach to a 60 km/h speed limit in a work zone can make road users aware of the reduced speed limit and influence them to decrease speed.

Rumble strips can be installed when the speed limit is less than 80 km/h and there is a minimum visibility distance of 80 m to the rumble strips.

An advance warning sign should be provided at location as described in Section 2.5.3 prior to the rumble strip to warn road users of the rumble strip ahead.

The placement of rumble strips on the inside of a left curve may not be as effective and may wear excessively on winding roads with many tight curves.

Rumble strips must be removed when the temporary speed limit is no longer required, and a higher speed limit is reinstated.

5.6 Safety Buffer

Safety buffers provide additional protection for road workers and road users extending around the work area. This includes on approach, to the side (adjacent clearance area) and above the work area. Safety buffers are not required on departure, however if a vehicle can approach the worksite from either end, a safety buffer should be provided.

Ensure that no works or road workers are within the safety buffer and keep the safety buffer clear of all types of work vehicles, plant, equipment, storage and stockpiled material.

Do not place any traffic control devices (e.g. signs, delineation) in the safety buffer. These belong in the advance warning area or additional warning area. The safety buffer may be used as an access point to the worksite however, road workers and vehicles should only enter under the supervision of a spotter or traffic controller to reduce the risk of traffic following them into the site.

A safety buffer must be provided immediately in advance of the work area where the speed is 60 km/h or higher. An area 20 m to 30 m in length is generally sufficient. However, if the work area is hidden from approaching traffic (e.g. by a crest or curve), the length of the safety buffer should be extended to a point which can be clearly seen by approaching traffic. On multilane roads, this may be increased up to 100 m.

Where works are being carried out above the road, a safety buffer of lateral separation is required to ensure road users are protected from falling objects by nets, platforms or other devices. Where works impose a temporary height restriction (e.g. safety platform or flashwork under bridge soffit), notification to and approval from the appropriate authority may be required, see AS 1742.3 for more information. Alternatively, close the respective part of the road (see Section 3.4).

5.7 Overhead Clearance

This is defined in the Austroads Guide to Road Design, Part 3, Table 8.1.

Where any part of construction or other works activity impinges on the typical minimum vertical clearances, traffic management will be required to identify the safe height of vehicles and to provide detours for any vehicles which cannot be accommodated.

Where works impose a temporary height restriction (e.g. safety platform or flash work under bridge soffit), notification to and approval from the appropriate authority may be required, see AS 1742.3 for more information. Alternatively, close the respective part of the road (see Section 3.4).

5.8 Additional Warning Area and Devices

If required, the additional warning area is a designated area that allows for the installation of additional traffic control devices, keeping them out of the safety buffer, and should be of sufficient length to contain the devices required. A flashing arrow sign should be placed in an additional warning area for as long as required when speeds are 60 km/h or above to provide additional communication of lane closure and assist road users in manoeuvring through a taper. Truck mounted attenuators (TMAs) are another example device most commonly used in this area, detailed in Section 5.8.1.

5.8.1 Truck mounted attenuators

TMAs are used at the worksite to provide physical protection to road workers from errant vehicles where road safety barriers are not practical. They are mostly used for mobile works (see AGTTM Part 4) with shadow vehicles, shielding road workers from passing traffic but can also be used for static worksites. Consider using a TMA in the following situations:

- works on category 2 or category 3 roads (80 km/h or higher) when road closure is not practical
- speeds below 80 km/h during high risk situations (e.g. night works)
- where road closure or road safety barriers are not practicable due to the short duration of works
- the work area is adjacent to or on a traffic lane
- to occupy a traffic lane on high speed, high volume roads while a merge is installed
- worker protection whilst installing traffic management devices
- for worker protection inside a worksite
- where maintenance road works presents a similar risk of exposure to errant vehicles.

If a TMA is impacted, it is possible that the vehicle will roll forward. This roll ahead distance is dependent on many factors including:

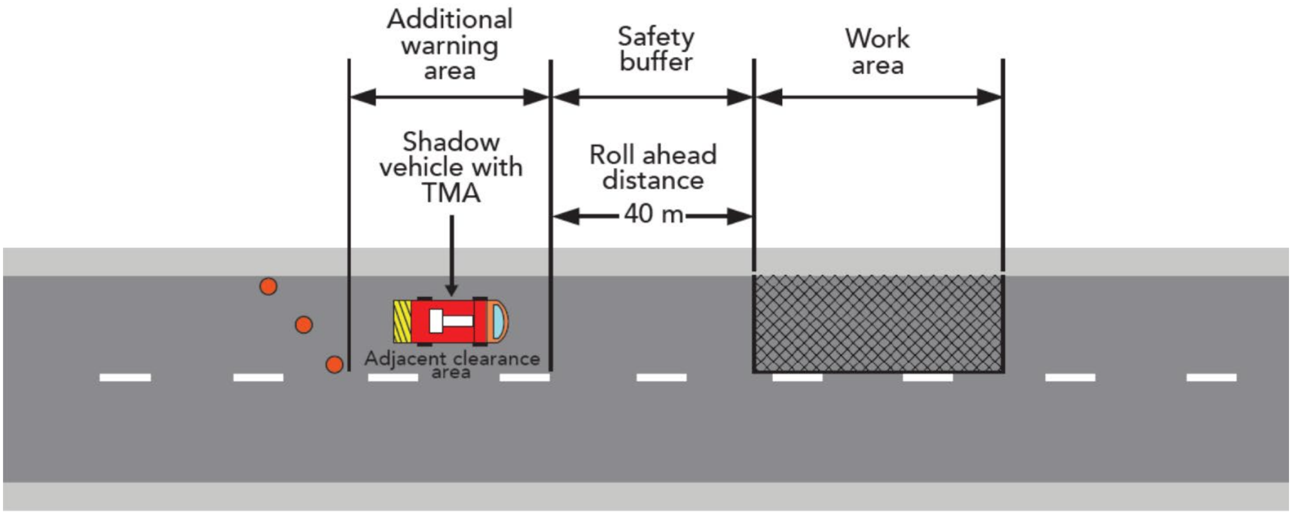
- angle of impact
- impact speed
- weight of the vehicle impacting the TMA
- weight of the vehicle mounted with the TMA

- pavement conditions
- brake engagement.

As such, a clear distance of at least 40 m must be maintained in front of the TMA to allow the mounted vehicle to safely roll forward if impacted, without entering the work area. This 40 m clearance is a safety buffer where road workers are not permitted to enter (see Section 5.6). Consider also an adjacent clearance area between the TMA and closest traffic lane.

Figure 5.10 illustrates a TMA mounted vehicle with roll-ahead clearance of 40 m. This diagram is not an example of how to install traffic control devices and is not to be used as a TGS diagram.

Figure 5.10: TMA set up on static worksites



5.9 Transition Area

The transition area is located between the two warning areas (advance and additional) providing a space where road users are redirected from their original path and relates to the delineation of the route (see Section 5.4). Treatments include tapers, chicanes, contraflow and crossovers.

5.9.1 Tapers

Use tapers to indicate closed lanes on roads and redirect traffic from their normal travel path to a temporary travel path. Tapers are created by placing delineation devices in a straight line or smooth curve across the width of the closed lane, directing road users into trafficable lanes. Types of taper include:

- traffic control taper
- lateral shift taper
- merge taper
- multiple tapers.

Traffic control taper:

- used where there is a PTCD or traffic controller prior to a lateral shift.
- see Table 5.7 for length of traffic control taper based on speed and Table 5.8 for distance between tapers.

Table 5.7: Recommended taper length

Speed (km/h)	Recommended taper length (m)		
	Traffic control taper	Lateral shift taper	Merge taper
≤ 45	15	5	15
46 - 55	15	15	30
56 - 65	30	30	60
66 – 75*	N/A	70	115
76 – 85*	N/A	80	130
86 – 95*	N/A	90	145
96 – 105*	N/A	100	160
≥ 106*	N/A	110	180

** Taper lengths are based on a:*

- *3.5 m width of the lane to be closed*
- *lateral shift taper length equal to 1.0 m/s lateral shift*
- *merge taper length equal to 0.6 m/s lateral shift*
- *median speed for each range. For example, speed range 76 – 85 has a median speed of 80 km/h.*

Table 5.8: Distance between tapers

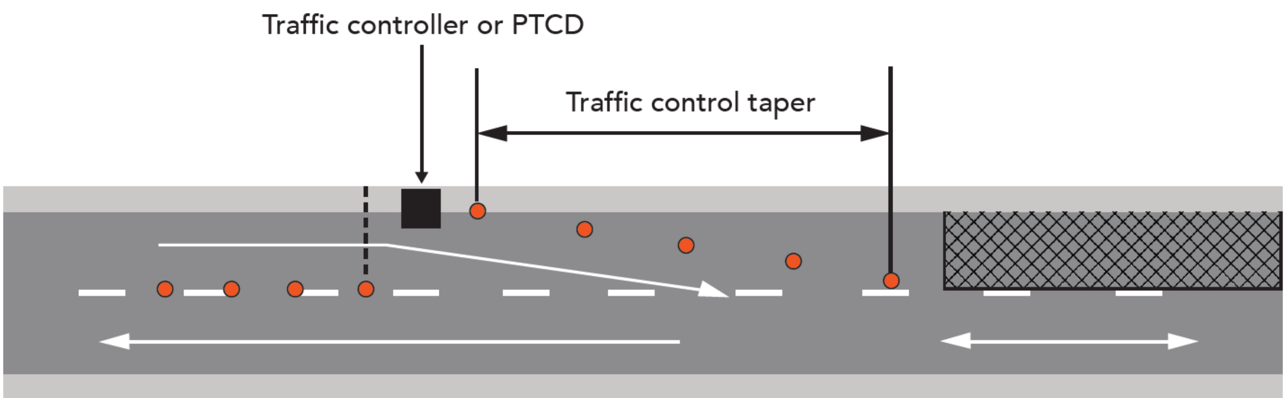
Speed (km/h)	Distance (m)
≤ 45	10
46 - 55	25
56 - 65	70
> 65	1.5 times the speed (km/h)

The speed to use in Table 2.2 and 5.8 must be as per Figure 2.2 of Section 2.5.3.

For details on how to use delineation devices see Section 5.4.

Figure 5.11 illustrates an example of a traffic control taper. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 5.11: Traffic control taper

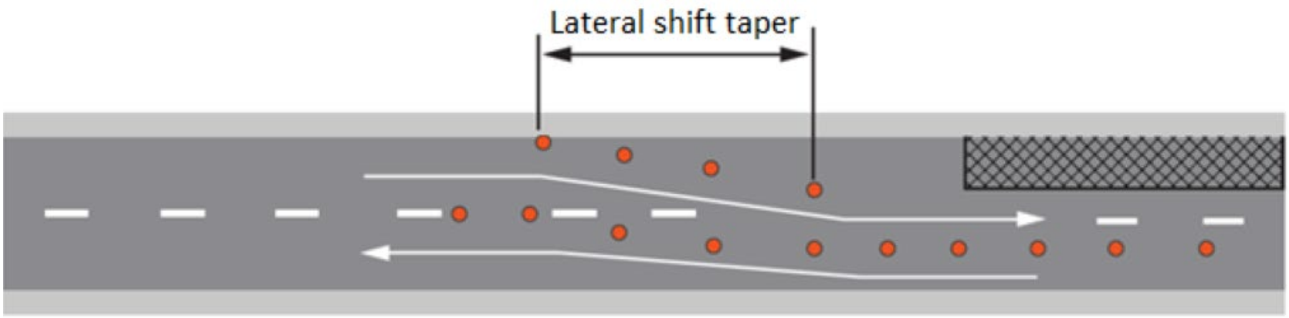


Lateral shift taper

- used where traffic is required to shift laterally without closing another traffic stream
- see Table 5.7 for length of lateral shift taper based on speed and Table 5.8 for distance between tapers. For lateral shifts over more than one lane the rate of shift is to be a continuation at the same rate.

Figure 5.12 illustrates an example of a lateral shift taper. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 5.12: Lateral shift taper

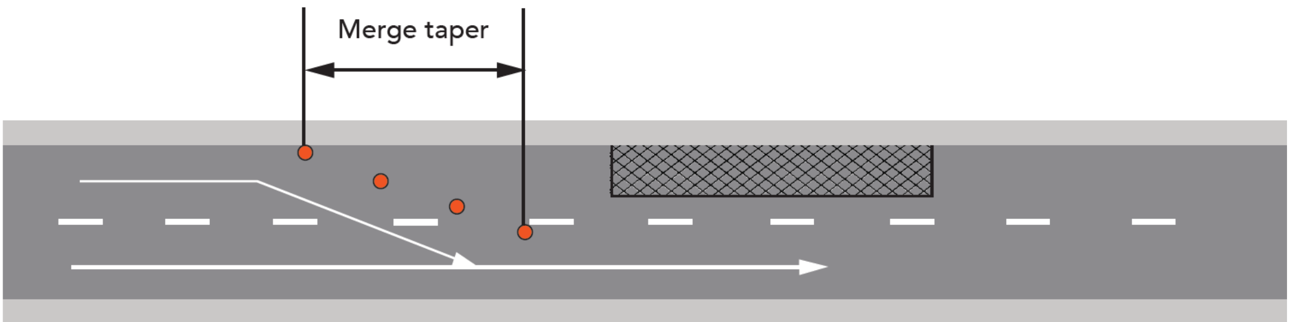


Merge taper:

- used on multilane roads where one lane of traffic is required to merge into another lane of traffic
- generally, a left-hand lane's traffic flow shifting laterally and merging into traffic flow in a right-hand lane
- merge tapers occur one lane at a time. Use a multiple taper for merges over multiple lanes
- see Table 5.7 for length of merge taper based on speed and Table 5.8 for distance between tapers.

Figure 5.13 illustrates an example of a merge taper. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 5.13: Merge taper

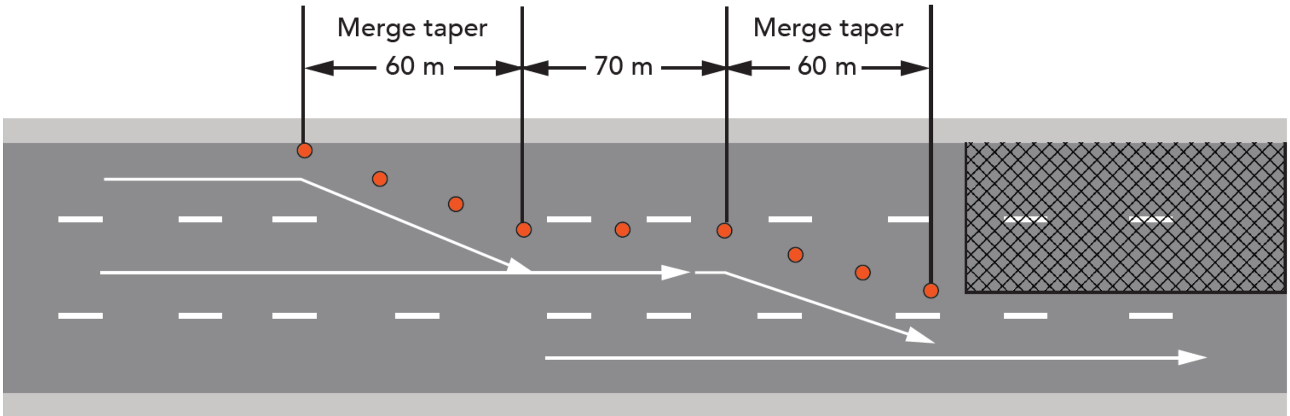


Multiple tapers:

- used for successive tapers, for example a merge followed by a lateral shift
- used for multiple merges where more than one lane is closed and close one lane at a time
- see Table 5.7 for length of each taper based on speed
- separate each taper by a minimum distance as shown in Table 5.8 so that drivers are only asked to do one manoeuvre at a time. The separation allows traffic to reset before doing the next manoeuvre.

Figure 5.14 illustrates an example of a multiple taper. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram. Distances are based on Table 5.7 for length of tapers and Table 5.8 for distance between tapers and a speed of 60 km/h.

Figure 5.14: Multiple tapers



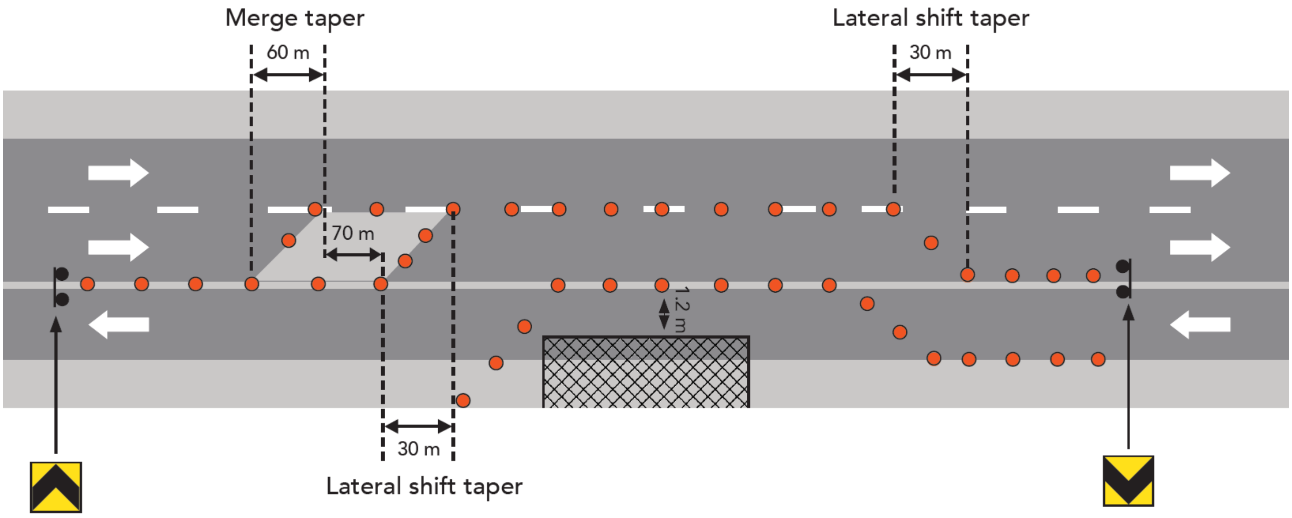
Designing a taper:

The following apply when designing a taper:

- Four cones spaced 4 m apart may be placed parallel to traffic before the taper as a lead-in. This is to provide better sight distance to the taper or to stop vehicles from parking too close to the start of the taper.
- The full length of a taper's delineation should be clearly visible to approaching road users. Adequate sight distance (see Section 2.5.4) allows drivers to plan their shift or merge. If this is not possible, the taper length should be extended so that at least two thirds of the taper is visible.
- Tapers should not be set up inside of any curve.
- Tapers prior to the start of curves and through intersections should be avoided. If lanes are closed through an intersection, the taper must allow for turning movements leaving or entering from side roads.
- Tapers must not start or end within 50 m of an intersection on Category 2 roads. In this case, the start of the taper is the point where the shift/merge finishes, and the end of the taper is where closed lanes are re-opened.
- Tapers must not start or end within 100 m of an intersection or on/off-ramp on Category 3 roads. In this case, the start of the taper is the point where the shift/merge finishes, and the end of the taper is where closed lanes are re-opened.
- The length of taper depends on vehicle speeds as shown in Table 5.7. In determining the length of the taper, the speed selected is based on the process outlined in Figure 2.2 to ensure that vehicles have adequate time to slow after passing a speed limit sign.
- No devices must be placed in the taper area except for those delineating the taper.
- Separate tapers, as shown in Table 5.8, so that drivers are only asked to do one manoeuvre at a time. An example is provided in Figure 5.15. The separation allows traffic to reset before doing the next manoeuvre. This also applies to distance between different types of taper (e.g. merge taper followed by a lateral shift taper).

Figure 5.15 illustrates an example of separate tapers. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram. Distances are based on Table 5.7 for length of tapers and Table 5.8 for distance between tapers and a speed of 60 km/h.

Figure 5.15: Example of separate tapers in a 60 km/h speed zone



Use one of the following delineation devices when creating a taper for consistency that ensures visibility, presence and effectiveness. Note that it can be supported by additional devices:

- traffic cones
- bollards
- line marking
- raised reflective delineating devices
- temporary hazard markers
- a clearly delineated road safety barrier system at speed limits of 60 km/h or less.

Figure 5.16 illustrates an example of lateral shift tapers on a two-way road using traffic cones. This diagram does not include all traffic control devices required and must not be used as a TGS diagram.

Figure 5.16: Two-way lateral shift tapers

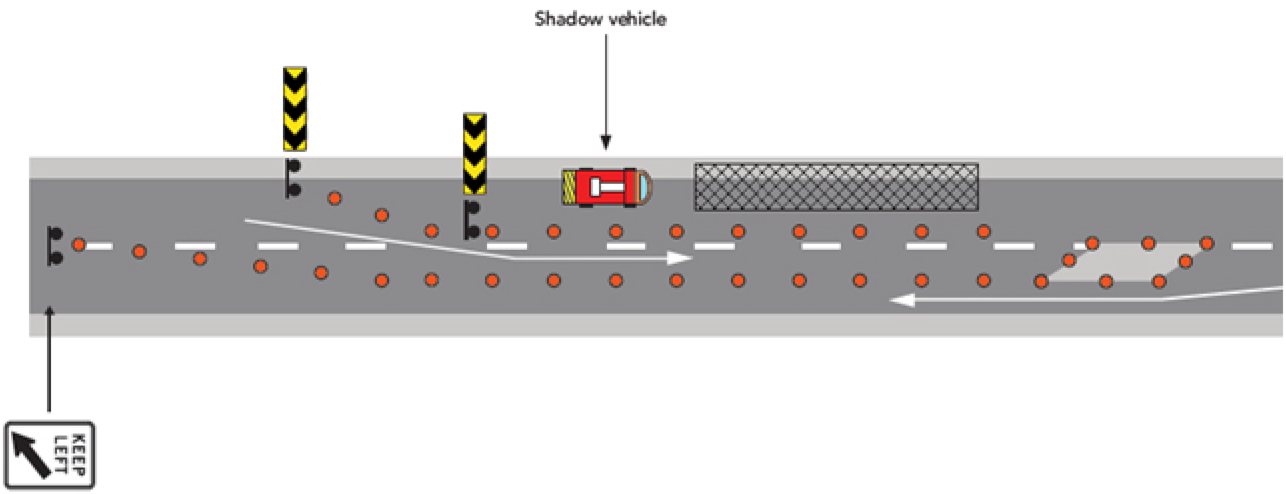


Figure 5.17 illustrates an example of centre lane closure and merge tapers on a two-way road. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram. Note that where there are three lanes moving in one direction and the central lane needs to be closed, then two lanes need to be closed to avoid traffic splitting into two lanes each side of the closed lane moving in the same direction.

Figure 5.17: Central lane closure

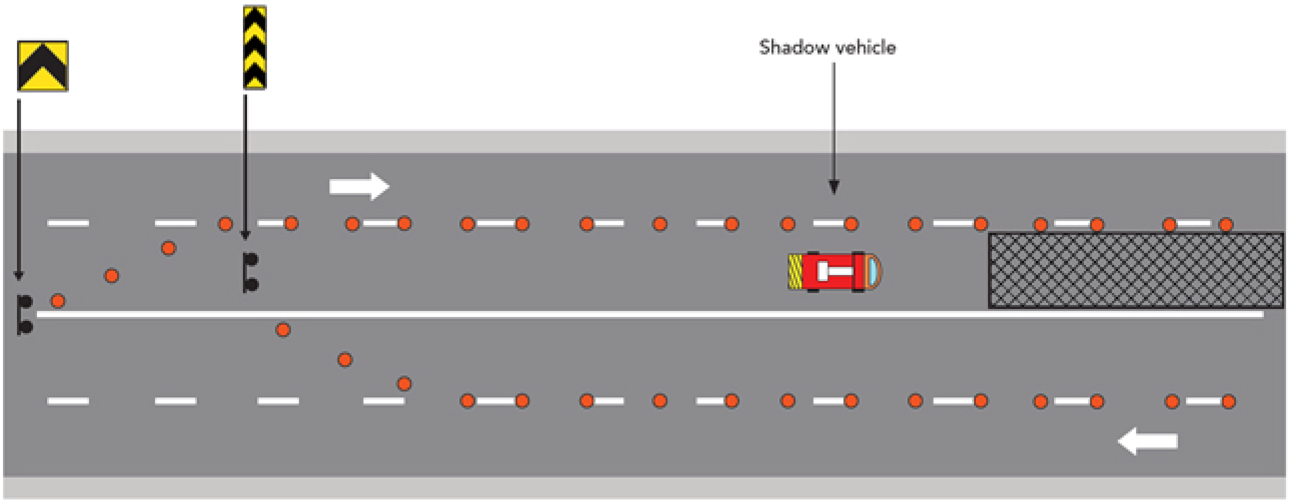


Figure 5.18 illustrates an example of a one lane closure and merge taper on a one-way road. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 5.18: One lane closure

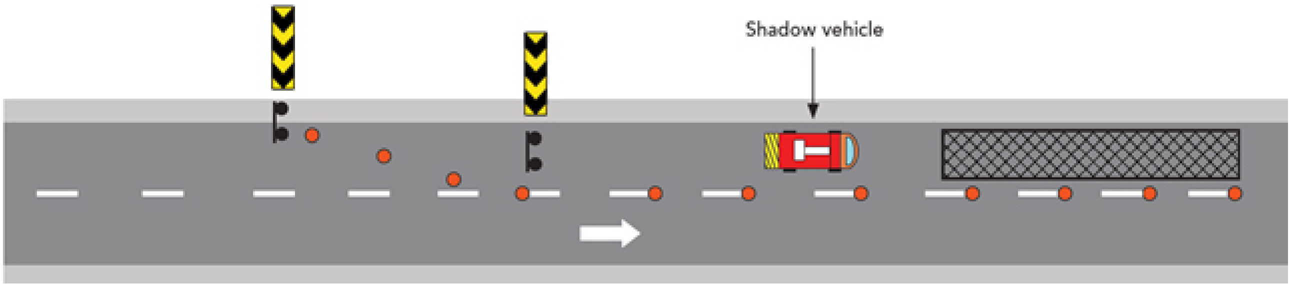


Figure 5.19 illustrates the typical site layout for works completed on a three-lane road, with works being completed in the right-hand lane. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram. The setting out of cones as shown in this scenario may be hazardous and would generally require all traffic in all lanes to be temporarily stopped for implementation and removal of the delineation.

Where a merge and lateral shift taper are situated at the same location, the length of both tapers will be as per a merge taper.

Figure 5.19: Traffic diversion for closure on right hand lane

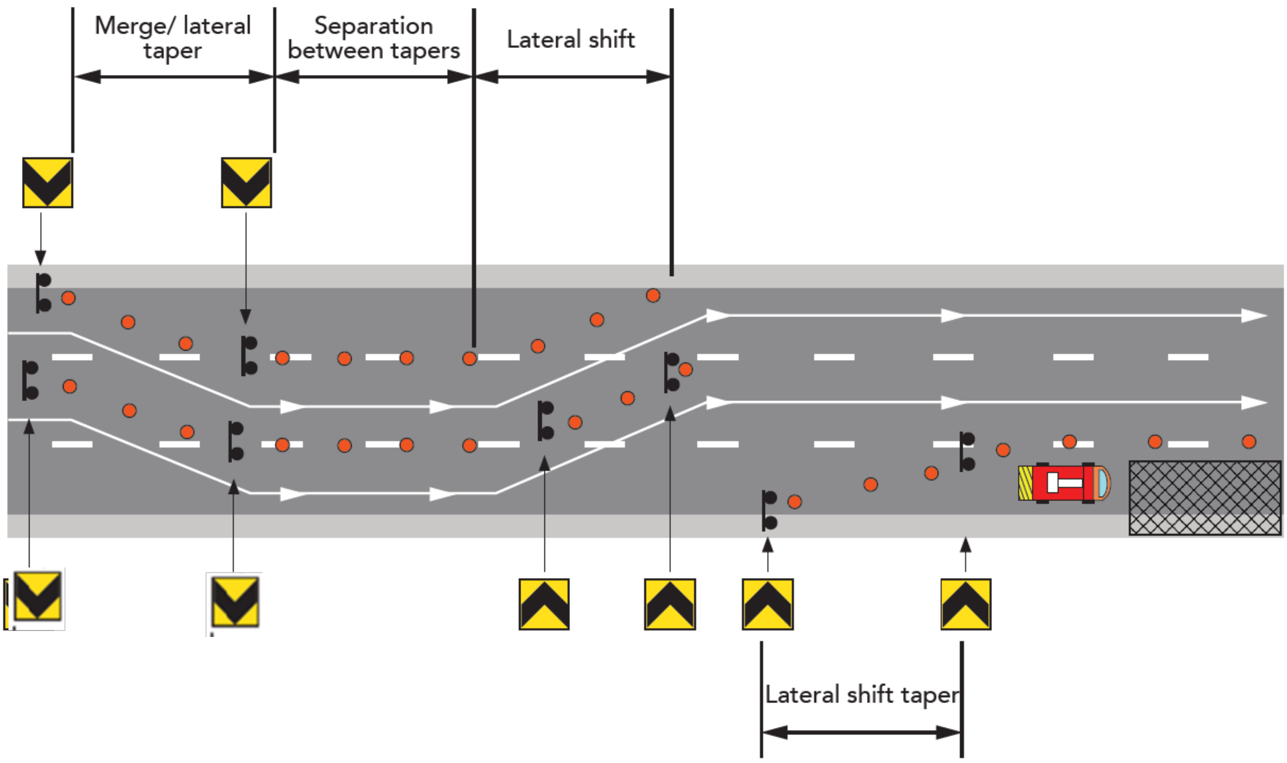


Figure 5.20 illustrates an example of lateral shift tapers on a two-way road using lane temporary line marking and temporary hazard markers for longer term worksites. Note that temporary line marking has been illustrated in black to differentiate from permanent markings but would be white in practice. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 5.20: Long term two-way traffic diversion

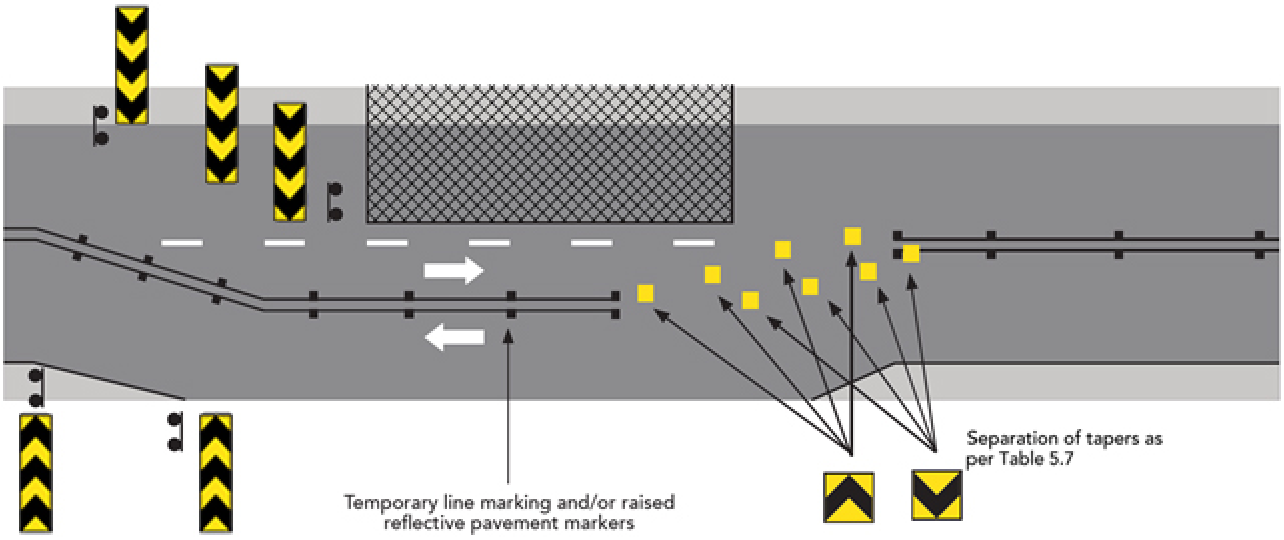
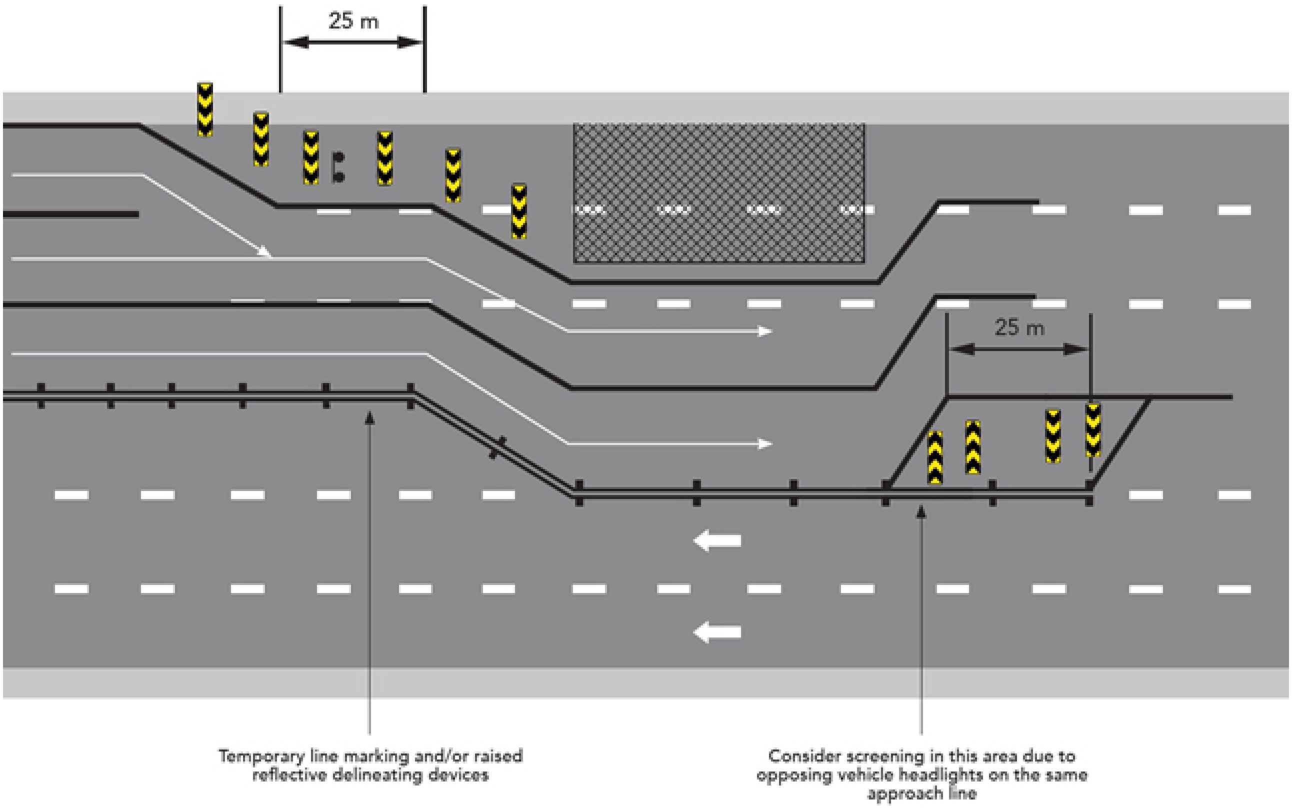


Figure 5.21 illustrates an example of multiple tapers using lane temporary line marking and signs for longer term worksites. Note that temporary line marking has been illustrated in black to differentiate from permanent markings but would be white in practice. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram. Distance between tapers is based on Table 5.8 and speed of 50 km/h.

Figure 5.21: Long term diversion, multiple lane shift



5.9.2 Chicanes

Chicanes are most commonly used to assist drivers when the works are undertaken on the right lane. When works are undertaken in a high-speed environment, it is recommended the use of a merge right and then a chicane to the left to decrease the speed of road users. See Figure 5.19 for an example of a chicane.

A chicane can be used to assist with reducing the speed of road users. A chicane involves lateral shift in advance of the work area and back again, directing road users to their original travel path to assist in reducing speeds of vehicles as they pass the worksite.

The length of a chicane is the same as for a lateral shift taper shown in Table 5.7. A chicane should be used when:

- there is sufficient length of road free of intersections prior to approaching the work area
- on rural roads with overtaking lanes
- merging multiple lanes into high-speed right-hand lanes.

Benefits of chicanes include:

- better controlled shifting/merging on high speed roadways
- approaches to the worksite are uniform
- shifting/merges occur well in advance of the worksite, calming traffic
- improved safety through the worksite
- reducing the speed of road users.

5.9.3 Contraflow

For a contraflow to occur, two-way flow must be maintained continuously, and one direction of traffic is on the opposite carriageway to normal operations. Contraflow is a traffic management treatment that is used when road works require one side of a multilane two-way road to be closed and traffic is transferred from its usual side to share the other half of the roadway with traffic moving in the opposite direction (temporary crossover). Traffic continues to flow in both directions at all times and as such, a contraflow is not the same as shuttle flow. Anytime traffic shifts onto the opposite side of the road and two-way flow is maintained continuously, this is defined as contraflow.

For 'past' methods, the worksite is separated from traffic by line marking or with median widths less than 6 m. For roads divided by permanent rigid safety barriers or with median widths of 6 m or more see Section 3.8.3, around the worksite treatment.

The scale of a contraflow is dependent on the lengths of works. When designing a contraflow, ensure the traffic knows they can't use the other lanes and do not encroach into the work area. Mitigation measures may include double barriers, wide centre lane treatment, warning sings, double arrow warning signs and arrows painted on the pavement.

When traffic is travelling temporarily in the wrong direction, apply the following safety treatments:

- Appropriate speed limits must be applied.
- A risk assessment must be undertaken and mitigation of any potential hazards resulting from the reversal of direction. For example, fixed roadside objects that are protected in one direction only (i.e. safety barrier and bridge parapet trailing ends that become leading ends).
- Check intersections. They may require to be temporarily modified to ensure that crossing and turning movements can be made safely by all road users. Any movements that cannot be made must be adequately catered for elsewhere within the road network to allow road users to reach their destination. If this requires a detour see Section 3.8.1.

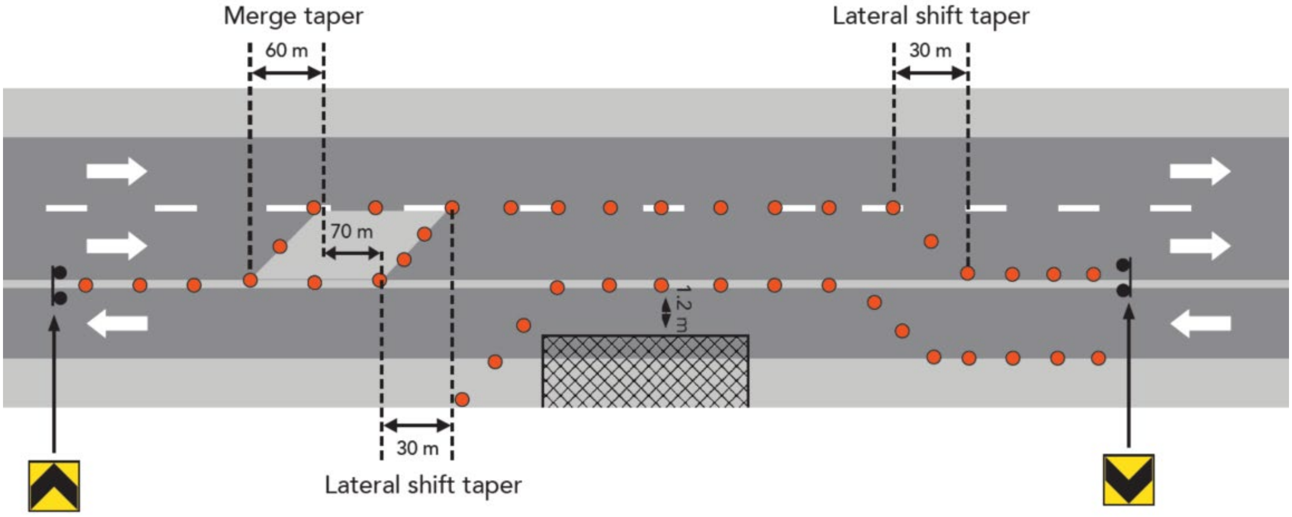
- LOOK BOTH WAYS, TWO-WAY TRAFFIC signs should be provided at side road approaches to warn traffic entering the main roadway. An example is illustrated in Figure 3.9. This diagram does not include all traffic control devices required and must not be used as a TGS diagram.
- The temporary diversion through the median must be delineated with line marking and/or traffic cones or bollards at 2 m spacing. Note that line marking is the preferred method of separation and is required for long term works. Cones or bollards should only be used for short term works.
- Consider the impact on vulnerable road users such as pedestrians and cyclists crossing two-way roads. If required, movements should be redirected to locations beyond the work area or provide zebra crossings (see Austroads Guide to Road Design Part 6A) and uncontrolled mid-block crossing points.
- Opposing flows must be delineated with treatment that removes the risk of encroaching into oncoming lanes, such as:
  - temporary barriers
  - wide centreline treatment
  - barrier line
  - cones or bollards.
- Other supporting measures include warning signs and devices, and pavement arrows should be considered following a risk assessment.
- If considering a wide centreline approach to opposing flows on a contraflow section, see Austroads Guide to Road Design Part 3, and separate opposing flows by 1 m at high traffic speeds and traffic volumes, reduce spacing of delineating devices by half or a quarter of spacing as shown in Table 5.3.

Note the following at intersections where there is traffic turning through a pedestrian/cyclist crossing point:

- Consider pedestrians with impaired vision, mobility, hearing or cognitive limitations
- containment fences and pedestrian mazes (if required) should be provided to control the location where pedestrians and cyclists cross the road
- traffic controllers may be required to patrol the site and assist pedestrians and cyclists crossing the road
- LOOK BOTH WAYS, TWO-WAY TRAFFIC signs should be provided to face pedestrians about to cross the temporary two-way road. An example is illustrated in Figure 3.9. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram.

Figure 5.22 illustrates an example of contraflow with delineation and separation for opposing tapers. Distances are based on Table 5.7 for length of tapers and Table 5.8 for distance between tapers, with speed of 60 km/h. This diagram does not include all traffic control devices and is not to be used as a TGS diagram. The recommended cone spacing for the lateral shift taper is a spacing of 2 m.

Figure 5.22: Contraflow with opposing tapers



5.10 Traffic Control

The control of traffic is managed by approved PTCDs or traffic controllers (manually). Where possible, PTCDs should be used to improve safety for traffic controllers. Control of traffic is used in the following situations:

- to provide warning or information (e.g. extended delay or follow pilot vehicle)
- to slow down, stop or direct traffic (e.g. site access, blasting works)
- to restrict or change the direction of traffic flow
- lookout duties for road workers during installation of traffic management devices
- shuttle flow
- emergency situations.

Consider the following when choosing an appropriate treatment to control traffic:

- risk assessment. Is it safe to use a manual traffic controller or is a PTCD more suitable?
- scope of works
- speed of traffic
- traffic volume. Do not use where traffic volumes are such that works may cause excessive delays to traffic flow. In these circumstances, PTCD or manual traffic control may not be appropriate.

5.10.1 Portable traffic control devices

PTCDs are the preferred method to control traffic. They are used to enhance the safety and protection of road users and road workers, specifically traffic controllers.

When using PTCDs, and situations occur where vehicles can bypass the temporary traffic control station, the placement of additional cones along the centreline must be installed to provide a sufficient distance to prevent the vehicle passing the PTCD. Prior to including a PTCD in a TGS, a risk assessment must be undertaken to ensure the suitability and choice of PTCD. Other considerations are as follows:

- impacts of equipment failure on road workers and road users. Employ back up traffic controllers in case of failure.

- background impacts on the visibility of the PRCD for approaching road users
- clear visibility and available sight distance (see Section 2.5.4). Install PTCDs on the left-hand side of each approach. If they are not readily visible in that location, they should be placed in a more visible position.
- speed of traffic
- traffic volumes
- duration of works
- can only be manually operated.

PTCD options include:

- Portable traffic signal systems (PTSS):
  - intended for shuttle flow (see Section 5.4.4) or gating (all stop) operation
  - available to provide control at intersections
  - signals automatically respond to traffic demands via vehicle actuated operation (unmanned)
  - option of fixed time operation that uses fixed timed cycles when traffic flow is relatively constant
  - may be used in manual mode but require qualified operators (i.e. traffic controller). Operators with two-way radio can monitor signal performance, warn the worksite and manage road users.
  - do not use where side roads intersect the worksite and are not controlled by a traffic controller or other PTSS.
- Portable boom barriers:
  - intended to stop traffic
  - manage shuttle flow or gating (all stop) operation
  - require qualified operators to operate in manual mode (i.e. traffic controller).

When using PTSS or portable boom barriers:

- they should be used as the preferred choice of traffic management, not as an alternative method to manual traffic control
- install additional cones (minimum 4) along the centreline to prevent vehicles bypassing the PTCD
- undertake a risk assessment.

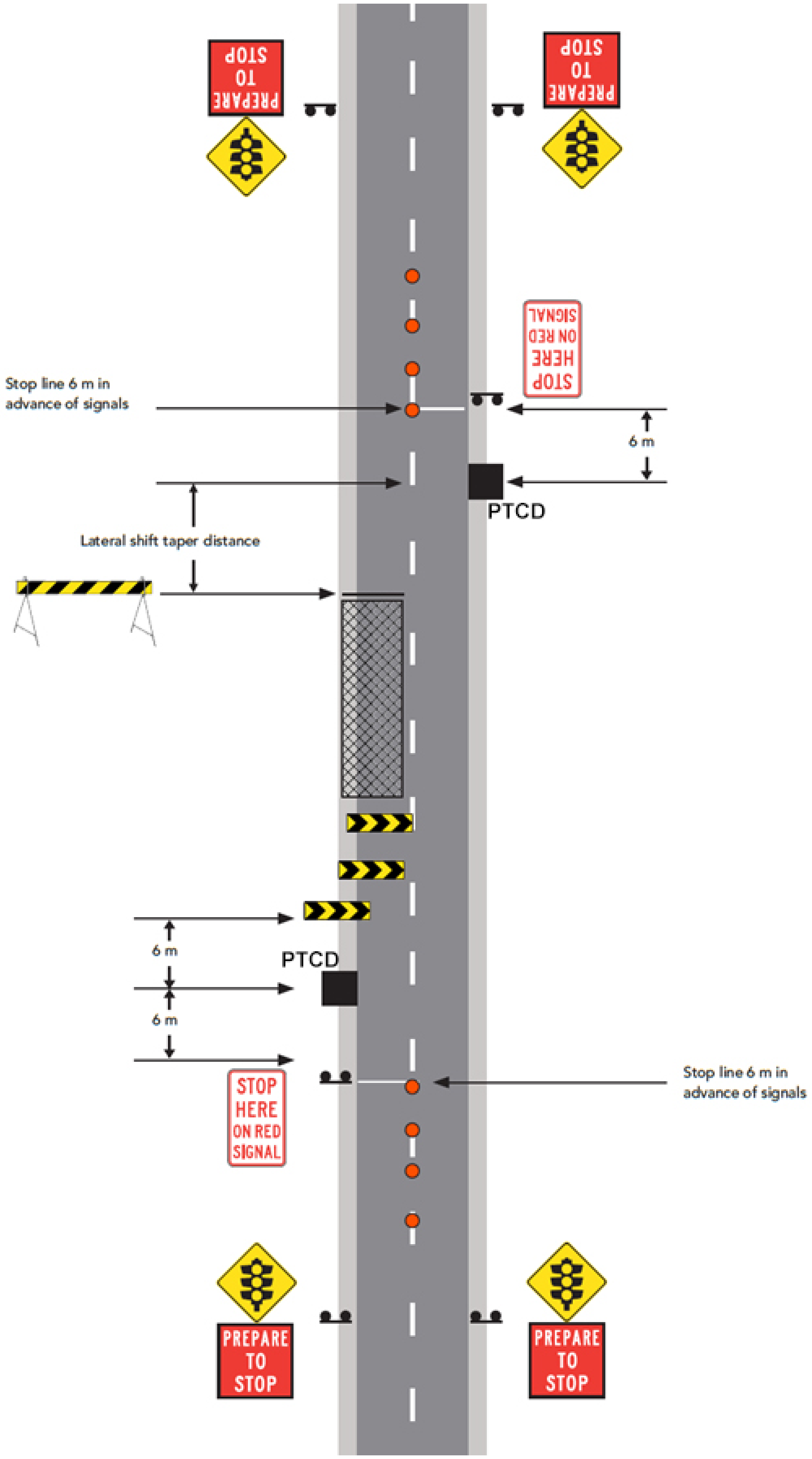
Note the following when using PTCDs:

- PTCDs require qualified operators (i.e. traffic controller).
- They are intended for traffic control of relatively short duration. For worksites that will continue for a longer period without work area location changes, consider installing temporary, rather than portable, traffic signals (see AS 1742.3.).
- Where traffic is required to stop, provide temporary road markings to indicate a stop line 6 m in advance of a PTCD. The sign STOP HERE ON RED SIGNAL must be used to indicate where road users are required to stop.
- Provide warning signs (e.g. Signals AHEAD) an appropriate sight distance in advance of any PTCD as shown in Section 2.5.3. See Section 4.8 for advance sign options. For PTCD the Traffic Controller (symbolic) sign is replaced with the relevant PTCD (symbolic) sign.
- Apply a temporary speed limit of 60 km/h or less if speed is above 60km/h (see Section 5.5.1) on approach to the PTCD.

- Regularly monitor PTCDs to ensure they are operating effectively and safely by checking that:
  - the settings are appropriate
  - the alignment of the signal displays is correct
  - the associated signs are intact and properly displayed
  - detectors are functioning correctly
  - there are no burnt out lamps
  - batteries are charged.

Figure 5.23 illustrates an example of PTCD and sign placement. This diagram does not include all traffic control devices required and is not to be used as a TGS diagram. See Section 4.8 for avoiding end of queue collision options and placement of signs. Traffic must be reduced to 60 km/h on any approach to the use of a PTCD.

Figure 5.23: Typical use of portable traffic control devices – 60 km/h road



5.10.2 Traffic controllers

Worksites are hazardous areas so use manual traffic control only where PTCDs are insufficient to provide the safety, capacity and efficiency required for effective traffic control. When traffic controllers are used, traffic controllers cannot direct a road user to contradict upcoming intersection signals. Traffic controllers are to coordinate activities with operating signals. If traffic controllers are operating within close proximity to a signalised intersection and the lights are flashing yellow or are off, a traffic controller must only control one lane and the approach to this intersection must be reduced to one lane of traffic. Where works cause delays to traffic flow or a side road intersects the worksite, do not use an automated PTCD, a traffic controller is required. The following requirements and recommendations apply when using traffic controllers:

- Only competent persons with appropriate certification must be appointed as a traffic controller (see AGTTM Part 7).
- Speed must be 60 km/h maximum. Provide a temporary speed limit of 60 km/h or less on the approach to a traffic controller if the speed is higher (see Section 5.5.1).
- An escape route must be identified for each traffic controller from their traffic control position.
- Traffic controllers must be positioned a clear sight distance from approaching road users (see Section 2.5.4) with no obstruction and where they are not obstructing visibility to traffic control devices (i.e. signs). No obstruction should be located in the area between the traffic controller and the end of the line of four cones.
- Ensure that a work vehicle is not parked in a way that impacts the visibility of the traffic controller or, limits the traffic controller's escape route or, is parked between the traffic controller and the taper.
- Ensure that traffic controllers are visible at all times of the day, particularly at dawn, dusk, against low morning or evening sun, when in the shade on a sunny day or working in dusty conditions.
- Ensure that traffic controllers are well illuminated at night. Where required, provide additional lighting.
- Relieve traffic controllers from traffic controller duties at least every 2 hours for at least 15 minutes.
- If cone tapers are used, position the traffic controller 6 m in front of the taper on the left-hand shoulder or edge of the road and facing approaching traffic.
- Place four traffic cones spaced 4 m apart, on the centre-line 6 m in front of the traffic controller position.
- If there is a queue, traffic controllers can move to the driver's side when safe to do so to remain visible to all road users.
- Under no circumstances are traffic controllers to stand or operate unprotected in a lane carrying traffic.
- Traffic controllers are to only communicate with a road user once the vehicle has stopped and is safe to do so.
- Ensure a single traffic controller never controls more than one lane of traffic or more than one approach. A single traffic controller can operate two PTSS at one time in special circumstances.
- Provide a traffic controller at intersections to guide road users entering from a side road.
- Some intersections require three or more traffic controllers. Where multiple traffic controllers are used they are required to:
  - ensure that road users are not seeing conflicting message from other traffic controllers at different locations of the worksite
  - be in continuous radio contact with each other when they are not visible to each other.

For detailed guidance on traffic controllers see AGTTM Part 7.

5.10.3 Site entry

It is important that when considering entry of vehicles into and through the site, that safety, trafficability, notification of any changed surface conditions and delineation be addressed, and risks mitigated. Consider using a lookout person and warning signs to prepare road users prior to work vehicles progressing out of the worksite and into the path of traffic.

When applying traffic control to stop traffic temporarily and allow work vehicles to traverse into or out of the work area use temporary traffic signals, PTCDs or traffic controllers using stop/slow bats. PTCDs or traffic controllers can be used to control the successive movement of work vehicles, plant and road users within the trafficable area. Traffic controllers may also be required to communicate information regarding delays to road users.

If speed is above 60 km/h, consider applying a temporary speed zone to provide warning and time for road users to slow down on the immediate approach to the work area (see Section 5.5.1). This is not always a requirement, except when traffic controllers are used at site entry.

Vehicles entering or exiting the worksite should do so in a manner that minimises impacts on traffic.

5.11 Advance Warning Area

The advance warning area is critical to the success of ‘past’ traffic management which is to provide no surprises to road users regarding traffic control by providing a controlled release of relevant information (e.g. signs) and providing repeated information where pertinent to emphasise danger. Advance warning signs and information also strengthen the delineation of a route and ensure that road users can safely and effectively navigate their way to their intended destinations.

Determine which signs to use (see AS 1742.3) and their layout with the road user in mind, avoiding confusion and excessive delay. Avoid driver overload that may cause road users to miss vital information. This can result from too many traffic control devices (i.e. signs), conflicting messages or lack of delineation. Placement and choice of advance warning devices will vary according to:

- speed
- clear sight distance to the works or hazard (see Section 2.5.4)
- obstruction caused by other road users
- the scope of works and changes necessary for effective and safe traffic management.

Advance warning signs are required in both directions for two-lane, two-way roads. When works are undertaken on multilane roads and the works are undertaken outside the roadway (kerb to kerb), advance warning may be omitted in the opposing direction subject to a risk assessment. If the works are in a lane on an undivided multilane road, advance warning signs are required in both directions.

For divided multilane roads, advance warning signs are usually only required in one direction, unless the work is carried out in the median.

Examples of advance warning signs include:

- ROADWORK AHEAD
- Speed Limit AHEAD
- BRIDGEWORK AHEAD for bridgeworks involving closure or detour
- Traffic Controller (symbolic), Signals Ahead, Boom Barrier Ahead or PREPARE TO STOP for active traffic control and the need to stop road users
- Worker (symbolic) in advance of the worksite (if road workers or plant are visible to traffic)

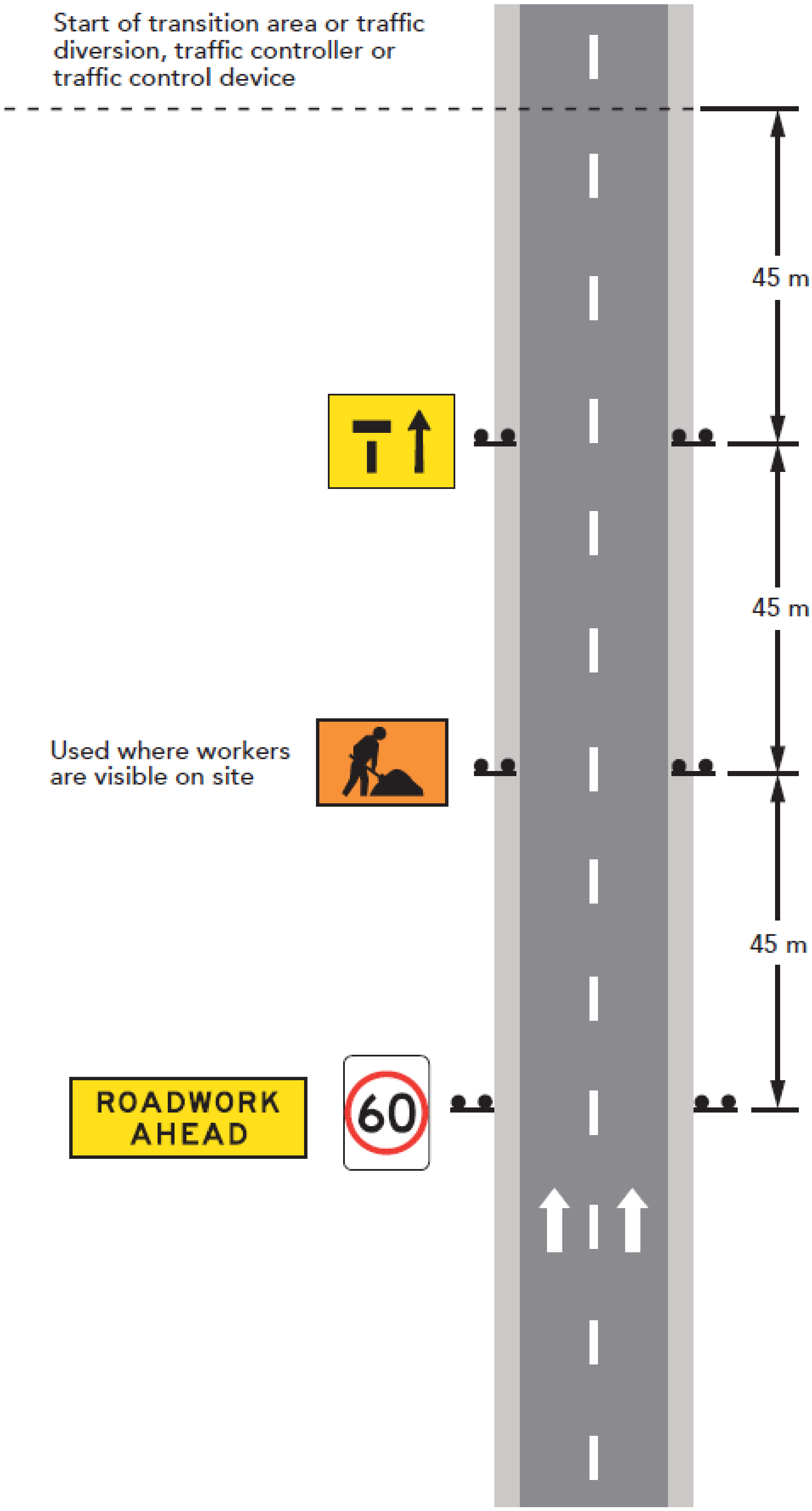
- Lane Status for lane closure
- Slippery, SOFT EDGES, ROUGH SURFACE, GRAVEL ROAD, Loose Stones or LOOSE SURFACE for hazardous road surface conditions
- ROADWORK X km or m AHEAD
- multi-message signs
- VMS.

Note the following when installing advance warning signs:

- Use flashing lamps to draw road user's attention to signs where lighting is poor or absent.
- Place advance warning signs at an appropriate distance measured from the hazard/worksite (see Section 2.5.3), with the sign closest to and advising the driver to react, to provide sufficient distance to any merge, lateral shift, significant pavement hazard, detour or to stop for traffic control.
- Ensure that advance warning signs have adequate sight distance to the sign (see Section 2.5.4)
- Space successive signs (after the primary sign) at a distance equal to those specified in Table 2.2.
- Place temporary speed limit advance warning signs as described in Section 5.5.1.
- For details on signs and sign placement see Section 2.5.3.

Figure 5.24 illustrates an example of advance warning sign placement. This diagram does not include all traffic control devices required and must not be used as a TGS diagram. The distance from the start of the work area to the first sign is based on appropriate distance for 60 km/h as shown in Table 2.2 whilst successive sign spacing is equal to Table 2.2.

Figure 5.24: Typical advance warning sign layout



5.12 Termination Area

The termination area is located at the end of a worksite (see Figure 5.2) and provides information to road users indicating the end of roadwork or temporary hazard and the resumption of normal traffic conditions. An END ROADWORK sign must be installed in the termination area whenever there is a ROADWORK AHEAD or ROADWORK NEXT X km sign.

Two-way roads require termination signs for outgoing traffic and advance warning signs for incoming traffic as the termination and advance warning areas are shared by road users travelling in opposite directions.

When terminating a temporary speed zone, Speed Restriction or END Speed Limit signs must be used. If this is required at two-way roads, the termination area speed limit stays in line with the speed reduction in the opposite direction for road users approaching the worksite (see Section 5.5.1). Speeds should increase after this zone. The END ROADWORK sign should not be located prior to reinstating of speed (speed increase).

Termination signs should be placed a distance (see Table 5.9) downstream from the last point on the road or verge affected by the worksite. The placement of these signs may be based on a completed risk assessment which considers the driver's behaviour and driver compliance. Consideration of the appropriate distance is important based on the following:

- If the termination sign is placed too far from the worksite, driver compliance with signs may reduce. Where only some drivers choose to comply, an additional risk of differential speeds of drivers in this zone may cause increased risk.
- If the termination sign is placed too close to the worksite, drivers may start to accelerate too close to the worksite, placing workers and other road users at risk.

These distances in Table 5.9 may be adjusted following the completion of a documented risk assessment or to avoid creating an offset speed zone.

Table 5.9: Placement of termination signs

Speed (km/h)	Distance (m)
≤ 55	15
56 - 65	45
≥ 66	Equal to the speed (km/h)

5.13 Vulnerable Road Users

Vulnerable road users include pedestrians, on-road cyclists, off-road cyclists and motorcyclists. Works that impact the road, road shoulder, bike lanes, crossings or pathways are likely to impact on these users. Where works affect vulnerable road users, TTM measures include:

- Road features that are hazardous to motorcyclists and on road cyclists should be treated. This may include transverse and longitudinal changes in pavement level, changes in surface condition and hazards on the road.
- Pedestrian and cyclists should not be led into direct conflict with the worksite or traffic moving around the worksite.
- Where pedestrians and cyclists are diverted onto an existing roadway, the new path must be separated from vehicular traffic by an appropriate traffic control method (e.g. delineation, barriers, warning signs)
- Cyclists may be directed into lanes carrying traffic if the traffic conditions are suitable for mixed traffic.
- Safe and obstruction free temporary paths must be provided where footpaths, bicycle lanes and/or roads used by public transport are blocked by the work.

- Pedestrian and bicycle paths should where possible, be provided on the same scale and to the same width as any facilities for pedestrian or bicycle traffic that existed prior to the works. If this cannot be achieved, ensure the safe movement of pedestrians, on-road and off-road cyclists through the area is provided to separate vulnerable road users from traffic.
- The diversion of pedestrians and cyclists must consider all appropriate clearances. This includes width and height.
- Shared zones need consideration and where possible, pedestrians should be excluded from the worksite completely.
- Pedestrians with impaired vision, mobility, hearing or cognitive limitations will be considered as part of the design, preparation, approval and implementation of TTM.

5.13.1 Pedestrians

Pedestrians, particularly school children, the elderly, vision, mobility, hearing impaired or people with cognitive limitations are vulnerable road users. Their safety at or adjacent to roadwork sites is an important consideration when planning for roadworks. Where footpaths or shared paths are impacted by roadworks, alternative facilities must be provided such as:

- footpaths
- pedestrian crossings
- crossing points
- refuges.

Whenever possible, design works so that existing pedestrian facilities are not impacted. It is acknowledged however that this is not always possible and alternate provisions need to be made. The following apply when designing pedestrian facilities:

- If permanent pedestrian controls (e.g. signals, signs) are not in place, a traffic controller should be used to safely direct pedestrians to appropriate crossing points and assist with crossing the road.
- Desirably, if footpaths or pedestrian crossings have been partially closed or temporarily relocated, a temporary footpath should be provided with minimum width of 1.8 m to allow for all pedestrians including those with mobility aids or on the same scale and to the same width as any facilities for pedestrian that existed prior to the works. This width should also be applied to any temporary ramps (e.g. kerb ramps). If these widths are not practicable, alternative routes must be provided with a firm smooth surface and no trip hazards in the following order of preference:
    1. on the side of a road reserve away from traffic
    2. between the work area and road but not in a traffic lane
    3. onto the road either in a lane used for parking or a delineated and protected section of an existing traffic lane
    4. across the road to a footpath on the opposite side with delineation at crossing points and kerb ramps. Consideration is required for persons with impaired vision, mobility, hearing or cognitive limitations. Only use this option if an appropriate crossing facility can be provided (see Austroads Pedestrian Facility Selection Tool).
    5. a traffic controller to safely guide pedestrians around the operation. Only use this option if there is no safe temporary path available.
- Appropriate surfacing must be provided for prams, strollers, wheelchairs or any other mobility aids.
- Temporary paths must be illuminated at night to the level of lighting previously available on the original footpath or crossing, or as referenced in AS 1158.4, whichever is the lesser level.

- Containment fences or longitudinal channelising devices should be installed at unattended worksites or where pedestrians may gain access.
- If falling debris is a risk and there is no alternative footpath available, a structure may need to be provided to protect pedestrians and a traffic controller provided to guide pedestrians safely past the hazard.
- Temporary crossings must be provided as near as practicable to pedestrian routes with the same level of functionality as the crossings they replace. This includes signals and provisions for people with vision, mobility, hearing or cognitive limitations.
- If a temporary crossing becomes unusable or the pavement markings are obliterated, cover any remaining indication of the crossing and install barricades/safety fences on both sides of the road to prevent access to the crossing. An alternative crossing system must be provided instead.
- If the roadway is converted from one-way to two-way and pedestrian crossings are required, note the following:
  - Containment fences (see Section 5.3.2) and pedestrian mazes should be considered to restrict where pedestrians cross the road. Ensure that containment fences do not put pedestrians at risk by impacting on visibility between vehicles and pedestrians, including children.
  - Traffic controllers may be required to provide guidance at pedestrian crossings.
  - LOOK BOTH WAYS, TWO-WAY TRAFFIC signs should be placed facing approaching pedestrians on both sides of the crossing
  - The crossing must be limited to a maximum of two lanes. If this is not practicable, provide a central refuge for pedestrians (see Section 3.8.3, Figure 3.9).
- Where pedestrians have been diverted onto an existing roadway:
  - The pedestrian path must be separated from other traffic with plastic mesh fencing (see Section 5.3.2); and
  - A minimum clearance of 1.2 m should be provided from the plastic mesh fencing to the nearest traffic lane for speeds up to 60 km/h. If this clearance is not practicable, the speed must not exceed a maximum of 40 km/h. If a temporary speed limit is required see Section 5.5.1; or
  - If speed is 70 km/h or more, a road safety barrier system must be used instead of the plastic mesh fencing. Pedestrians must be clear of the deflection zone behind road safety barriers.

For detailed guidance on pedestrian paths see Austroads Guide to Road Design Part 6A.

For detailed guidance on traffic control devices for pedestrian control see AS 1742.3.

5.13.2 Cyclists

Cyclists are vulnerable road users. Their safety at or adjacent to roadwork sites is an important consideration when planning for roadworks. Where shared roads, paths or bicycle paths are impacted by roadworks, it is necessary to provide alternate facilities. If a bicycle path exists that will be impacted by roadworks, the preferred approach is to maintain an alternative path not on a shared road. Note the following when designing facilities for cyclists:

- Are cyclists currently sharing traffic lanes, using bike lanes or shoulders, or riding on pathways?
- Relevant warning signs should be used to warn cyclists of any changes.
- If the existing bicycle path is on-road and affected by works, a temporary bicycle path should be provided elsewhere to a similar standard.
- Alternative paths off-road are desirable.
- If there is insufficient width for a temporary bicycle path (same width as the existing bicycle lane), merge cyclists into an existing traffic lane or shoulder. This will include:
  - appropriate approval as required by the Road Infrastructure Manager

- delineation (see Section 5.4)
- additional signage should be placed to alert road users of merging cyclists. This signage must be placed at the relevant stopping distance in advance of the closed section of the bicycle lane.
- consideration of differing speeds and behaviours between cyclists and other road users. Cyclists tend to move slower and in a different manner to other road users.
- separating cyclists from other road users by time, if the existing traffic lane is narrow or rough, by allowing other road users to manoeuvre past the worksite first and cyclists second. Traffic controllers must be provided to ensure that no other road users follow behind cyclists until they have cleared the area. Multiple traffic controllers will be required, one for traffic and one for cyclists.
- a temporary speed limit for road users should be applied to provide safe entry of cyclists into traffic lanes.

5.13.3 Motorcyclists

Although motorcyclists are a part of traffic flow on the roadway, they are considered vulnerable road users. Issues to consider regarding the impact of works on motorcyclists and their safety include:

- Has the location of traffic control devices that might destabilise a motorcycle been avoided on their travel path?
- Is there sufficient clearance of obstructions (e.g. signs, delineation) so that motorcyclists can lean into curves?
- Is the advance warning and delineation adequate for motorcyclists?
- Is the road surface safe for motorcyclists?

5.14 Public Transport

The following issues to consider, in conjunction with a risk assessment and TMP, will assist with mitigating the impacts of works on different modes of transport, connections and users.

- Have the needs for public transport been considered, adequately signed and catered for?
- Have the needs of public transport users been considered?
- Have the manoeuvring needs of public transport vehicles been considered?
- Have bus stops been well positioned for safety?

Where activities impact public transport facilities, note the following:

- Approval must be obtained from the relevant public transport authority to conduct works around tram lines and/or bus stops.
- Bus stops should be relocated to a temporary position if required.
- Detours should be provided for bus services if required. Detours must have an acceptable swept path and turning circle for buses.
- Safe passenger access to and from bus and tram stops must be provided.
- Appropriate warning to public transport passengers and road users should be provided by use of warning signs, delineation and/or barriers.

6. Design for Additional Issues

6.1 General

Previous sections provide specific guidance for ‘around’, ‘through’ or ‘past’ methods of traffic management. When designing a worksite layout, the information provided in this Section is to be considered and applied where appropriate conditions exist. One or more of the below considerations may be relevant depending on the location of works, scope and nature of the works and road conditions/environment.

6.2 Permanent Traffic Signals

Works near permanent traffic signals that alter approach speeds, traffic volume, lane availability or approach alignment can significantly impact traffic signal operation due to damage of vehicle detection systems (sometimes extending up to 120 m in advance), hardware, cabling or generate false demands. Consultation with the relevant road infrastructure manager on design strategies for TTM at worksites near permanent traffic signals must be undertaken during the planning phase and be included in the TMP (see AGTTM Part 2).

6.3 Roundabouts

If an appropriate safety buffer cannot be applied for works on or adjacent to a roundabout, close the roundabout and provide a detour (see Section 3.8.1).

If a detour cannot be provided (e.g. in rural areas), operations on or adjacent to a roundabout can be managed by placing PTCDs or traffic controllers using a STOP/SLOW bat prior to approach islands of the roundabout and carrying out operations on one quadrant at a time.

On multiple lane roundabouts where works are confined to one lane, all entrances are to be reduced to one lane and respective lanes closed except where required for exits.

6.4 Overtaking Lane

Where works occur within an overtaking lane (e.g. rural roads) the following apply:

- advance warning signs should be placed on both sides of the road for both directions of travel
- if the start of the first taper is less than 600 m from the start of the overtaking lane, the overtaking lane should be closed from its start point to the end of the worksite and cover all signs relating to the overtaking lane
- if the start of the first taper is more than 600 m from the start of the overtaking lane, install a taper in advance of the worksite (see Section 5.9.1)
- if the overtaking lane extends for 600 m or more beyond the worksite, open the remaining length of the overtaking lane
- if the overtaking lane extends for less than 600 m of beyond the worksite, keep the overtaking lane closed.

600 m is based on the distance required to safely pass another vehicle at 100 km/h whilst allowing for a safe sight distance ahead. This distance can be reduced in consultation with the relevant RIM based on local conditions if traffic is travelling much slower (e.g. on steep gradients).

6.5 Shoulder as a Temporary Lane

If traffic volumes are expected to exceed the capacity of the road during works, the shoulder may be used as a temporary lane considering the following:

- moving road users to the shoulder may bring roadside hazards within the clear zone
- Is the shoulder safe for traffic to navigate at the given temporary speed limit?
- Is the shoulder strong enough to carry heavy vehicles or expected vehicles masses for the road?
- Is the shoulder at least the minimum lane width for the speed, for the entire length required?
- Does the shoulder have adequate overhead clearance?
- Is the shoulder clearly visible along its length? Trim vegetation and move traffic control devices with permission from the relevant authority if required.
- Will surface height level changes impact road users? The profile needs to be a smooth transition for the safety of road users and delineated on both sides, unless the shoulder is closed.
- Is the shoulder unsealed? Maintain the surface condition and ensure vehicles are not moving along the shoulder, half on the seal and half on the soft shoulder.
- the condition of the shoulder to be utilised and also the impact to the shoulder and the water table by trafficking the shoulder
- the possibility that cyclists are using the shoulder and the need to safely mix or separate cyclists from traffic.

6.6 Pavement Markings

This section refers to pavement markings in existence prior to road works. The following apply for pavement markings:

- where appropriate, existing pavement markings can be used to guide road users
- where existing markings are satisfactory they are to be maintained in good condition throughout the works
- Existing markings that are not appropriate or potentially misleading must be removed and replaced with more suitable markings. The material used to obliterate existing markings should not make the road surface slippery or leave a mark which could be confusing to road users especially at night or in wet weather.
- markings must not be covered using black or grey paint as under certain light or wet weather conditions they may appear indistinguishable from white markings
- for shorter term worksites, temporary tape/stickers may be used to cover line marking or other pavement marking (e.g. turning arrows)
- pavement marking, such as tape or temporary line marking, must be retroreflective for all temporary lines to emphasise the travel path
- raised reflective delineating devices should be used with temporary lines to guide traffic through substantial detours or changes in direction
- raised reflective delineating devices must be used as delineation where a section of roadway is left for a period of time without line marking (e.g. pavement surfacing)
- ROADWORK AHEAD or CHANGED CONDITIONS AHEAD signs must be used for situations where road users will experience changed road conditions, including the absence of line marking
- NEW WORK NO LINES MARKED and NO LINES DO NOT OVERTAKE UNLESS SAFE signs must be used in the absence of lines

- raised reflective delineating devices should be used in conjunction with temporary hazard markers where appropriate on longer worksites
- temporary stop lines must be applied when resealing roads through intersections with traffic signals or STOP signs
- temporary lines, signs and redundant pavement markings must be removed on completion of works. Redundant pavement markings should be removed by grinding off or water blasting.

6.7 Night Works

Undertaking work at night is effective in reducing delays to traffic because traffic volumes are normally less than during most daylight hours. However, work at night requires careful additional planning and inspection.

When planning night time traffic management measures, the following apply:

- many visual cues available during the day are not available to drivers at night
- consider the use of TMA(s) to increase visibility and provide forward warning to motorists as well as protecting workers
- PPE with increased night time visibility e.g. reflective tape
- noise limitations
- traffic demand will be lower, so traffic speed may increase
- road user and road worker visibility are reduced
- road user and road worker awareness may be reduced due to fatigue, increasing the risk of error
- the potential for road users to be affected by drugs or alcohol is increased
- traffic management methods may be different
- ensure additional lighting for the entire worksite including traffic controller locations, pedestrian and bicycle lanes. Mount lighting so that it directs light downward. Do not use light sources that produce glare that could become disabling or confusing for road users.
- use a VMS to increase visibility of warning
- traffic controllers using illuminated wands
- install delineation devices. Consider impact of reflective components from multiple rows of delineation.
- flashing lamps can be used for delineation if the flashing lamps are smart devices
- flashing lamps can be used to warn pedestrian and cyclists of upcoming hazards they need to be aware of
- consider flashing lamps to alert drivers
- flashing lamps must not take away the purpose of advance warning signs
- place flashing lamps on barricades or fences where there is a hazard on a footpath or bicycle lane
- place flashing lamps on the corner of barricades or fences to ensure the worksite or hazard is clearly visible
- Use flashing lamps as part of the advance warning for the worksite. Place them at least 500 mm clear of traffic lanes on Category 1 roads and at least 1250 mm clear of traffic lanes on Category 2 and 3 roads. Ensure that whatever is holding the lamp is collapsible on impact.

6.8 Excavations

An excavation is a longitudinal depression with a side slope of 1.5 horizontal to 1 vertical or steeper adjacent to traffic.

Excavations require special consideration to ensure their structural integrity and minimise the risk of road users losing control and driving into them, and the safety of road workers. Consider also any above ground hazards near the excavation (e.g. signs, other devices, excavated material).

Consider the following when designing road user protection around an excavation:

- risk assessment
- length of the excavation adjacent to the roadway
- clearance between the excavation and the nearest traffic lane (see Table 6.1)
- width of the excavation
- depth of excavation
- duration of exposure
- speed
- traffic volume
- road alignment
- safe placement of material excavated.

Where an excavation is readily accessible to any person and likely to collect or retain water of such a depth as to constitute a danger, or is left unattended, it is required that:

- the excavation is fully covered, fenced or backfilled when the worksite is unattended
- the excavation is covered, fenced or filled when work is completed
- only approved skid resistant plating must be used to cover an excavation
- fully enclose the excavation. Do not use barricades, traffic cones or plastic mesh fencing that is not supported by a solid frame as they are not sufficient to adequately protect road users from excavations.

Table 6.1 shows clearance between an excavation, or any ground level hazard associated with the excavation, and the nearest traffic lane, relative to speed and traffic volume. The delineation method is also shown as one of three options. These are as follows:

- Option 1. Use traffic cones or bollards spaced as shown in Section 5.4.1.
- Option 2. Use traffic cones or bollards spaced at 4 m maximum.
- Option 3. Use a road safety barrier system (see Section 5.3.1).

Table 6.1: Delineation adjacent to excavations

Speed (km/h)	Traffic volume (vpd)*	Clearance to excavation (m)	Protection required		
			Depth of excavation (mm)		
			50 to 250	251 to 500	>500
≤ 65	Any	< 2.5	Option 1	Option 2	Option 3
		2.5 - 5	Option 1	Option 1	Option 2
		> 5	Option 1	Option 1	Option 1
≥ 70	≤ 1500	≤ 5	Option 1	Option 2	Option 3
		> 5	Option 1	Option 1	Option 1
	> 1500	≤ 6	Option 1	Option 2	Option 3
		> 6	Option 1	Option 1	Option 1

** For multilane roads use volume in one direction. For two-lane, two-way roads use the sum of both directions. Any variations to the recommendations in this table need to be supported by a risk assessment.*

*** For Options 1 and 2, cones or bollards are to be placed at the top of the excavation.*

6.9 Unattended Worksites

The planning and layout of an unattended worksite is included in the TMP. The following apply when preparing the worksite to be left unattended:

- The length of the worksite should be reduced as much as possible.
- If temporary speed limits have been installed, they must be removed unless conditions remain which still requires a reduced limit. Changes to the temporary speed limit need to be approved and recorded.
- Sweep any loose material from the road surface.
- Check that all signs are secured and positioned correctly. Remove or cover any signs that are not required.
- Check that all delineation devices, especially signs, are clean, secure and positioned correctly.
- Adequate lighting is provided for clear visibility at night.
- Ensure there is enough warning (e.g. signs, other devices) for road users, including vulnerable road users, to pass the worksite safely. For the management of vulnerable road users through the worksite, see Section 4.10.
- Provide additional traffic cones if required. For example, if the closure is on a corner or over a hill, extend the traffic cones further towards the approaching traffic to provide clearer guidance.
- Store all equipment, machinery and materials out of the way. Do not leave them in the safety buffer, within a taper, placed on curves or anywhere they may be struck by an errant vehicle or create a hazard to road users, especially vulnerable road users.
- All plant and equipment should be parked such that it does not create an additional hazard for road users.
- Park plant within the worksite at least 6 m clear of the nearest traffic lane. If this is not practicable and the speed is 60 km/h or less, place plant in a parking lane subject to:
  - the plant being registered for on road use
  - the plant is parked on the same side of the road as the work area
  - the plant is parked under street lighting or in a lit area
  - the parking of plant is approved in the TMP
  - if plant is parked on shoulder a ROADWORK AHEAD sign must be used.

6.10 Placement and Operation of Portable Variable Message Sign (VMS)

6.10.1 Principles and guidance

a. Placement of the VMS is important to ensure that the sign is visible to the road user and provides ample time to take any necessary action.

b. Placement should be in accordance with these guidelines and the traffic management plan prepared for the works.

c. Where motor driven generators are used, the emitted noise of the equipment should comply with all regulations applicable to the control of environmental noise in the relevant area.

d. Pedestrian traffic, cyclists, other road signing, adjacent properties and businesses should not be adversely affected by the placement of the VMS.

e. If it is practicable, a portable VMS should be secured to an immovable object to prevent theft, tampering or interference.

6.10.2 Aiming distance

Wherever practicable, a VMS should be aimed to the centre of the nearest lane for approaching traffic, using the desirable aiming distance specified in Table 6.1 below, and as shown in Figure 6.2. If the VMS displays two screens, more distance is required for motorists to read and comprehend the sign.

Table 6.2: Desirable Aiming Distance

Speed (km/h)	Desirable Aiming Distance (m)	
	One Screen	Two Screens
≤ 60	65	90
61 to 80	105	140
81 to 100	160	200
> 100	190	235

6.10.3 Longitudinal placement

a. Depending on the application of the VMS, there are a number of positions at which it could be placed. For messages that require an action, the VMS should be placed approximately 12 seconds of travel time upstream from the decision point. For freeways, a VMS should be placed 300 metres in advance of a worksite. For messages advising of forthcoming works, it is important to locate the VMS close to the area that will be affected so that road users can make a judgement as to whether it concerns them.

b. A VMS should generally be positioned well upstream of the advance warning signs for mobile works or frequently changing work areas. Up to two kilometres from the actual work activity is considered appropriate. However, depending on travel speeds and roadway conditions, this distance may vary so road users have sufficient time to make any necessary decisions.

c. A vehicle-mounted VMS may be used for slowly moving and mobile operations if available and if there is adequate shoulder width to permit the vehicle-mounted portable VMS to be at least one kilometre behind the operation. Caution should be used to ensure that the portable VMS is not so far from the worksite that the effect is diminished. Alternatively, a distance qualifier should be used to indicate when road users will encounter the works.

6.10.4 Lateral placement

A VMS should be placed on the side of the roadway closest to the affected travel lane, being normally the left side of the roadway. Lateral positioning of a VMS should have regard to Figure 6.1 and the following:

a. Where there is a kerb, the portable VMS should be positioned behind it.

b. If there is no kerb, it should be placed on the verge outside of any shoulder or emergency lane.

c. Where practicable, the portable VMS should be positioned behind semi-rigid or rigid protection (e.g. guard fence, wire rope).

d. For urban roads, the portable VMS should be located to ensure it does not interfere with pedestrians, cyclists and other footpath users.

e. If placing a portable VMS behind the kerb is not an option, a parking lane can be used although care should be taken in ensuring that it does not encroach into any traffic lanes and the lane is properly closed off to through traffic.

6.10.5 Visibility

a. The VMS should be clearly visible and legible from all traffic lanes and remain legible until the vehicle is no more than 30 metres from the sign.

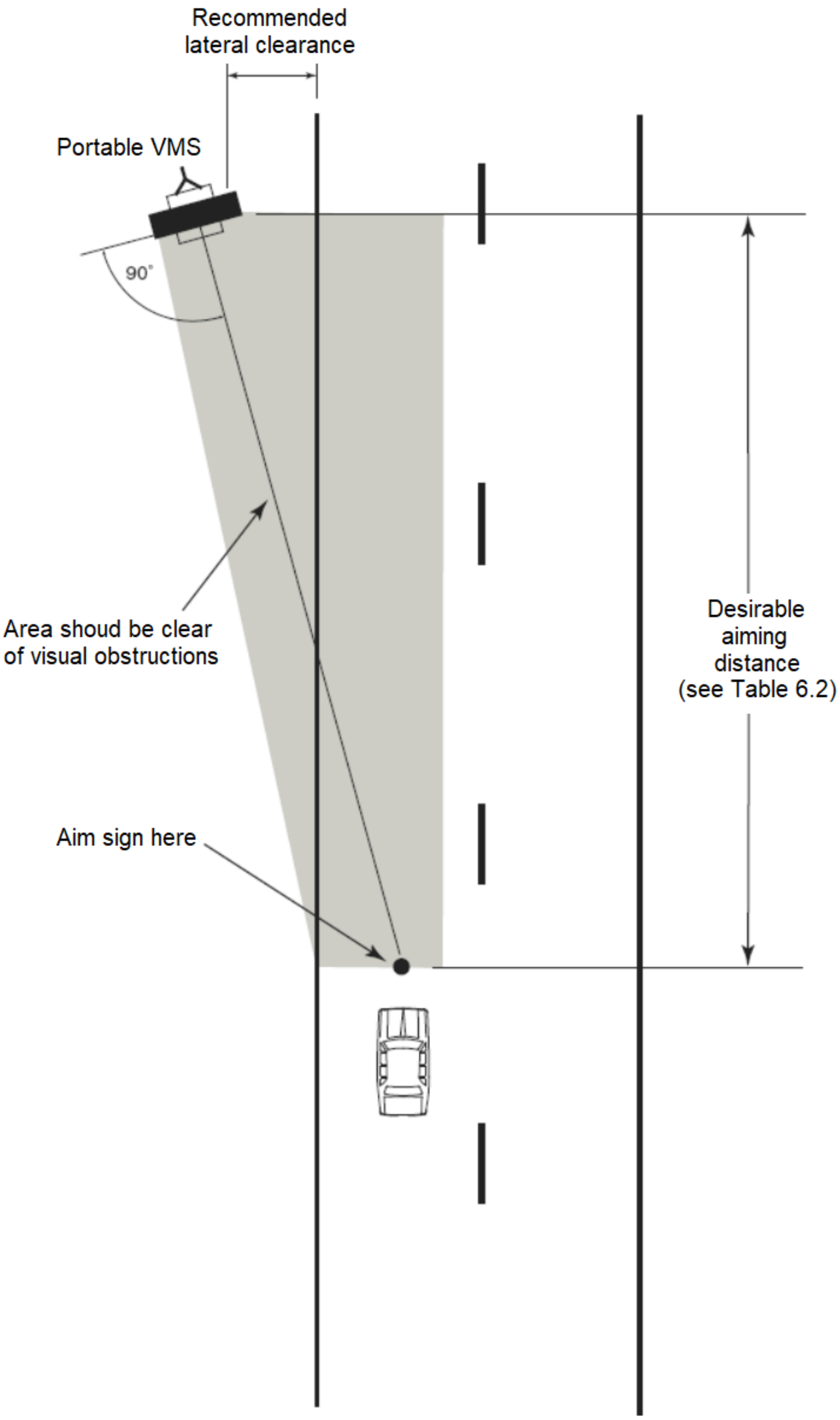
b. Elevating the VMS increases the visibility of the sign to oncoming traffic so it can be viewed from behind other vehicles. Where the VMS is located in the vicinity of pedestrians or cyclists, the bottom of the sign should be a minimum of 2.2 metres above the ground for pedestrians and 2.5 metres for cyclists. Note that the VMS should also have sufficient clearance from any overhead electrical wires.

c. Signs should not be placed in sags or just beyond crests and should not be obstructed from view by vegetation, parked vehicles, or other roadside visual obstructions.

d. On curved alignments, in order to meet sight distance requirements, the VMS should be located at the start of the curve, or if not practicable, in such a way as to maximise the sight distance of the sign.

e. Also to be taken into consideration is specular reflection, background conditions (including lighting), and oncoming headlights.

Figure 6.1: Typical portable VMS placement



7. How to Apply the Traffic Guidance Scheme

7.1 General

This section provides brief guidance on the installation, monitoring, maintenance and removal of traffic management treatments. For detailed guidance see AGTTM Part 6.

7.2 Pre-installation

Undertake the following checks prior to works being conducted on site:

- confirm the TGS has been signed off by the relevant personnel
- confirm that OHS paperwork (e.g. job safety awareness forms) have been completed and signed off by the construction supervisor or relevant person
- confirm that appropriate PPE is used
- confirm that a copy of the authorised TMP and TGS is onsite at all times during the works
- confirm that all devices and equipment listed on the TGS have been checked for faults and accounted for prior to leaving for site. Check that devices:
  - have no bends, breaks or surface damage
  - are clean
  - not colour faded to a point where they have lost their impact
  - have effective reflective surfaces.

7.3 Installation

When designing a TGS, the designer must consider and document the process for installing traffic control devices:

- Ensure they do not conflict with information on any existing signs or warning signs already erected. Cover or remove any existing signs that are not relevant during works (see Section 2.5.3).
- Ensure they do not create an unavoidable hazard for road users or road workers.
- Ensure they are efficient, logical and quickly isolate the work area from road users.
- Signs must be installed in the appropriate order as detailed in AGTTM Part 6.
- Position signs as per the requirements in the TGS and AGTTM Part 6.
- Ensure traffic control devices will be clearly visible to approaching road users (see Section 2.5.3).
- Ensure traffic control devices are effectively stable (see Section 2.5.3).
- Ensure suitably trained workers can install and remove traffic control devices on roads, with appropriate protection, which may include a TMA.
- Install from the non-traffic side of a vehicle, the rear of the vehicle if a shadow vehicle is provided or 10m in front of the vehicle.
- Ensure vehicles used to install traffic control devices and equipment have a flashing lamp and arrow board clearly visible to approaching road users.

Before work commences, erect traffic control devices in accordance with AGTTM Part 6. Once all signs are installed, erect tapers and other delineation devices. Drive through and check the worksite to confirm:

- it is safe for both roadworkers and road users
- it is to the standard shown in the TMP and TGS
- the restriction to traffic flow is reasonable
- the signs and delineation devices give clear messages to road users
- the signs and delineation devices are securely erected and will remain in their correct position under the expected traffic volumes and weather conditions.

7.4 Removal

As per the installation, the designer should stipulate the process and order of removal of the traffic control devices in the TGS.

7.4.1 Redundant devices

Redundant equipment is signs, supports, bases, delineators or other equipment not in current use. This includes equipment not required when the site is left unattended.. All redundant equipment must be removed from the site or placed in a safe, secure location within the worksite. Note the following when storing redundant equipment:

- The equipment does not remain on site and unused for a period greater than 48 hours unless securely stored.
- The equipment is stored in a safe location where it will not pose a hazard to any person or property.
- The equipment must not be stored or placed on an open footpath or bicycle path.
- The equipment is stored at least 6 m clear from traffic.
- The equipment is not stored in a location which is visible to traffic and which could be confused with installed devices, especially at night with retroreflective components.

Temporary signs may be covered when the site is not attended, provided they are to be used again and do not constitute a hazard or obstruction. Permanent signs which will be returned to service when works are complete, may be covered provided they do not constitute a hazard or obstruction.

7.4.2 Ghost markings

Old or temporary markings must be adequately erased to avoid misleading road users with ghost markings during wet and low light conditions. The standard for line removal is as per jurisdictional requirements however, note the following:

- all paint that exists outside the specified tolerances is removed
- a satisfactory level of removal is achieved so that it cannot be distinguished by road users and the final surface texture is similar to the surrounding pavement
- it is acceptable for some marking material to remain in the gaps of the pavement surface.

See also Section 6.6.

7.5 Inspection and Record Keeping

TTM devices and equipment is subject to wear and tear that occurs during normal use which does not occur with permanently installed equipment or devices. Much of this wear and tear occurs during the storage, travel, installation, relocation and removal phases and causes deterioration in the appearance and effectiveness of the equipment and devices.

Whenever a high number of these worn and damaged devices are installed on a worksite, the general appearance of the worksite deteriorates, reducing the credibility of the devices and thus reducing the level of safety for both road workers and road users.

See Part 6 for more information about checking and assessing the condition of devices.

Keeping records of variations and incidents is an important part of the works process. Note the following when keeping records:

- requirements for reporting of incidents either witnessed or reported, involving the public or from which legal proceedings might arise. Many jurisdictional authorities have standard incident reporting procedures, depending on the type and severity of the incident, and these should be implemented as appropriate
- the required frequency of record keeping. This is generally daily or at each set up
- the format of records and storage requirements (e.g. paper based or electronic)
- the minimum requirements, including identification of the job and reference number of the TMP or TGS, date, location
- Any departures from or additions to treatments applied, name of the person keeping the record, and of authorised person making changes should be recorded on the TGS transmittal of records to the relevant jurisdictional authority or supervisor, as required.
- see also AGTTM Part 6 and Part 8.

References

New Zealand Government 2018, *Code of Practice for Temporary Traffic Management*, New Zealand Transport Agency, Wellington New Zealand.

Australian Standards

AS 1742.3-2019, Manual of Uniform Traffic Control Devices Part 3: Traffic control for works on roads

Austroads' Guide to Temporary Traffic Management (AGTTM) details contemporary temporary traffic management practice for application in Australia and New Zealand. It provides guidance for the planning, design and implementation of safe, economical and efficient temporary traffic management designs.

Guide to Temporary Traffic Management Part 3:Static Worksites has been prepared to assist with the preparation of traffic guidance schemes, in accordance with Austroads best practice. It provides general information about the context and components of designing temporary traffic guidance schemes at static worksites.

Guide to Temporary Traffic Management Part 3

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