



Guide to Temporary Traffic Management Part 4

Mobile Works



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Guide to Temporary Traffic Management Part 4: Mobile Works

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Abstract <p>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.</p> <p>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.</p> <p>Part 4 has been prepared to assist with mobile worksites, in accordance with Austroads best practice. It provides general information about the context and components of designing temporary traffic guidance schemes at mobile worksites.</p>	About Austroads <p>Austroads is the peak organisation of Australasian road transport and traffic agencies.</p> <p>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.</p> <p>Austroads provides a collective approach that delivers value for money, encourages shared knowledge and drives consistency for road users.</p> <p>Austroads is governed by a Board consisting of senior executive representatives from each of its eleven member organisations:</p> <ul style="list-style-type: none">• 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 to Temporary Traffic Management including all 10 Parts.
Part	The description for the individual documents within the Guide. This document is Part 4 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 4 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 1.1 and in Table 1.2

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

Overview	Part 1: Introduction		
Planning	Part 2: Traffic Management Planning		
Design	Part 3: Static Worksites	Part 4: Mobile Works	Part 5: Short Term Low Impact Worksites
Field	Part 6: Field Staff – Implementation and Operation		Part 7: Traffic Controllers
Support	Part 8: Processes and Procedures	Part 9: Sample Layouts	Part 10: Supporting Guidance

Table 1.2: Parts of the Austroads Guide to Temporary Traffic Management

Part	Title	Content
Part 1	Introduction	<ul style="list-style-type: none"> • Introduction to the discipline of TTM practices • Breadth of the subject and the relationship between the various Parts of the Guide • Legislative relationships • Links to related jurisdictional documentation • Definitions
Part 2	Traffic Management Planning	<ul style="list-style-type: none"> • Broad strategies and objectives to provide effective TTM 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 TTM at road worksites • Process for planning and documenting TTM
Part 3	Static Worksites	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • On site risk assessment • Installation and removal of TTM schemes • Operation and monitoring of TTM schemes • Record keeping
Part 7	Traffic Controllers	<ul style="list-style-type: none"> • Training competencies • Instructions on practices • Control devices that can be used
Part 8	Processes and Procedures	<ul style="list-style-type: none"> • Road network classification • Powers, roles and responsibilities • Training competencies • Forms and procedures • Model contract specification
Part 9	Sample Layouts	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Risk management processes • Review, inspection and road safety audit of worksites • Events • Emergency works

1.3 Scope of Part 4

AGTTM Part 4 provides guidance to designers on TTM at road worksites. This 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 deals specifically with those worksites which involve vehicles moving progressively along the roadway at speeds significantly lower than other traffic. All signs and devices are either vehicle mounted or moved along the roadway as works progress.

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

Aspects covered in AGTTM Part 4 for the design of TTM include:

- general design considerations for mobile works
- selection of appropriate mobile work practices
- the design process to be followed for the design of mobile works
- detailed design guidance for each step in the design of mobile works
- 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 4 to New Zealand

Readers in New Zealand should note the following in application of Part 4 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. This 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 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 Mobile Worksites, a TMP and TGS are required. Numerous and specific TGS 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 mobile works, 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 and implementing 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 as required to suit site conditions and the scope of works.

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

- determine whether mobile works are an appropriate traffic management measure by answering YES to the questions and dot points below:
 - Is there clear sight distance to the vehicle mounted warning device for approaching drivers (based on the speed of traffic)?
 - Is the vehicle mounted warning device clearly visible (not obscured) to all road users?
 - Are all resources for the mobile works available (including a shadow vehicle)?

If these are not achievable, see AGTTM Part 3: Static Worksites.

- risk assessment (see Section 2.2)
- determine the method of traffic control
- determine road work impacts and method of management.

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 TGS for more extensive or complex works 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 needs to be approved by the relevant road infrastructure management (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 attained by constantly 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 evaluating risks involved in the design of the TTM for mobile works are shown in Table 2.1. This is not an exhaustive list and other site-specific risk considerations may be applicable.

Table 2.1 Risk considerations

Risk Category	Considerations
Road worker safety	<p>There is an obligation on both organisations and road workers, together with 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:</p> <ul style="list-style-type: none"> • maintenance of an acceptable clearance from traffic • traffic control (e.g. temporary speed limits) • appropriate training for all road workers and compliance of appropriate work methods and safety requirements. <p>Risks for road workers include:</p> <ul style="list-style-type: none"> • 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.

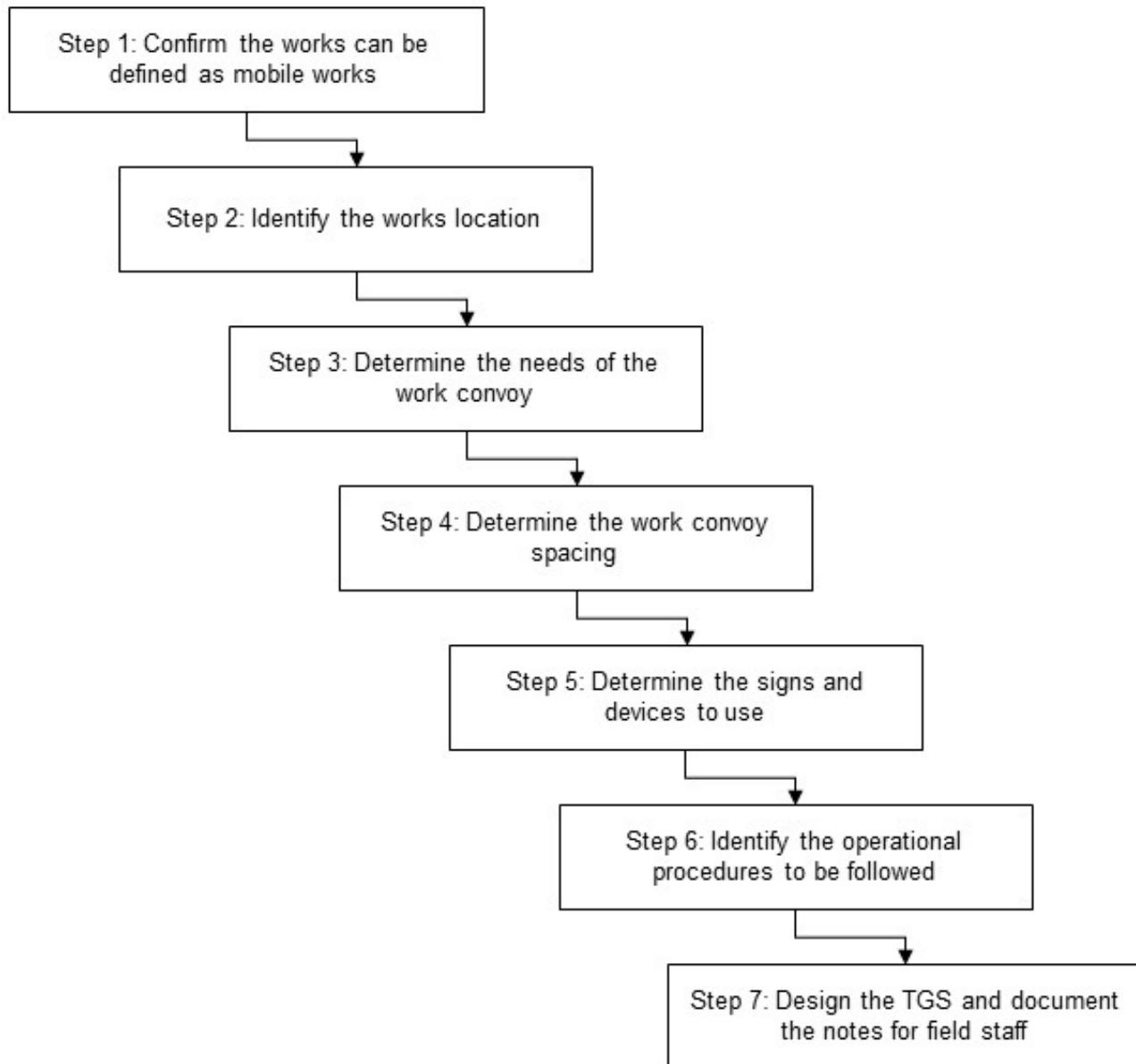
Risk Category	Considerations
Road worker safety (cont)	<p>All road workers should:</p> <ul style="list-style-type: none"> • sign the SWMS prepared for that site and contribute to the risk assessment • immediately report any unsafe conditions • take reasonable care for his or her own personal safety and the safety of all road users • consider any requirements specific to night time works • take reasonable care that his or her acts or omissions 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. <p>Personal protective equipment (PPE) is essential for the safety of road workers and should 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 PPE may include:</p> <ul style="list-style-type: none"> • head protection • eye protection • hearing protection • sun protection • reinforced toe cap boots.
Road users	<p>Road users (including vulnerable road users) need to perceive and process information, make decisions, act, and monitor conditions within time constraints. Safe driving and riding occurs 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.</p> <p>Risks associated with road users include:</p> <ul style="list-style-type: none"> • 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. <p>Safe traffic management should:</p> <ul style="list-style-type: none"> • warn all type of road users of any hazard or changed conditions • guide and inform the road user • control the road user's speed and passage around, through or past the worksite • consider driver behaviour and make allowance for human error and errant vehicles. <p>Questions to ask include:</p> <ul style="list-style-type: none"> • is the permanent speed limit safe for all types of 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	<p>Vulnerable road users have different and special considerations compared to those of general road users. Consider pedestrians, including school children and road users with impaired vision, mobility or cognitive limitations.</p> <p>Where works affect vulnerable road users, ensure that:</p> <ul style="list-style-type: none"> • they are not led into direct conflict with the works or traffic moving around, through or past the worksite • if pedestrians or cyclists are directed into live lanes they should be adequately protected from traffic • safe and impedance free temporary paths are provided. <p>See <i>road users</i> (above)</p>

Risk Category	Considerations
Site conditions	<p>Considerations relating to the impact of the road and roadside environment should include:</p> <ul style="list-style-type: none"> • road category and traffic volumes relative to the time of day and day of the week (see traffic volume (below) and AGTTM Part 8) • 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 AGTTM Part 3) • road features (e.g. sealed, condition of seal, unsealed, available lanes, shoulder widths, intersections, railway crossings, bridges, intelligent transport system (ITS) devices 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 • drainage management • where possible, source current site information including through on-site inspection, photos or videos.
Parked vehicles	<p>Vehicles parked on or adjacent to the road, including any work vehicles affect safety in several ways:</p> <ul style="list-style-type: none"> • as physical obstructions that 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	<p>Issues associated with adverse weather conditions should be identified in the TGS and include appropriate contingency plans.</p> <p>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.</p> <p>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:</p> <ul style="list-style-type: none"> • type of adverse weather condition (snow, frost, fog, rain, wind) • the complexity of worksite • traffic volumes • road surface • time of day • appropriate lighting • sun glare or areas of shade.
Unattended worksites	<p>Unattended worksites contribute additional risks and further considerations should be given to:</p> <ul style="list-style-type: none"> • the undesirable movement of traffic control devices • damage to traffic control devices • injury due to entanglement, falling, crushing, trapping, abrasion, tearing • other incidents which may occur whilst the worksite is unsupervised.

2.3 Design Steps

The development of a traffic guidance scheme (TGS) for a mobile worksite requires safety to be considered through the design process. The seven recommended design steps are summarised in Figure 2.1 and explained in further detail in subsequent sections.

Figure 2.1: Mobile worksite design steps



2.4 Design Balance

The optimum mobile work design involves developing a TGS that finds the right balance for road users, including vulnerable road users, road workers, the traffic management team, contractor 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 and/or road authority) regarding effective and efficient TTM that is appropriate for each project during the design phase.

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
- the full extent of the work area within the worksite
- required traffic control devices and equipment
- availability of traffic control devices and equipment. Not all first-choice equipment will be available for the worksite. Consider what other devices may be used as an acceptable replacement
- any specialist input 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 Sight distance

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
- obstructions (e.g. safety fences, boundary fences, barriers, parked cars, street furniture, landscaping, signs)
- railway crossings
- bridges
- traffic queues
- weather (e.g. linemarking visibility in the rain and fog)
- 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)
- other vehicles closely following each other
- other local site features.

Sight distance must be considered to access points in or out of the worksite to pedestrian or cyclist paths to prevent conflict.

Recommended sight distances for static signs that are used to support mobile works convoy are provided in Part 3. For signs mounted on vehicles, the sight distance from approaching road users is to match the sight distance requirement to the vehicle mounted warning device of:

- 150 m for traffic speeds 60 km/h or less
- 250 m for traffic speeds greater than 60 km/h.

2.5.3 Signs

Signs indicate the nature of the hazard or work. For details on choosing an appropriate sign (see AS 1742.3). Once an appropriate sign is chosen, its location needs to be incorporated into the TGS. Questions to consider include:

- 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 users? Sight distance for road users entering from side roads or private driveways must also be considered. Consider also the impact of sign clutter, permanent versus temporary signs and the positioning of the mobile convoy. The aim is to give road users sufficient warning when approaching a hazard (see Section 2.5.2)
- Are the signs placed at an appropriate height for the road users?
- Will signs be easily understood?
- Are additional vehicles required to act as a 'repeater' of signs?

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

- signs must be securely mounted on vehicles in a prominent location
- avoid placement or messages that could direct road users into incorrect or dangerous situations
- vehicle mounted variable message signs may be used to display signs or instructions as part of a mobile works convoy
- signs that are not relevant during works must be removed or covered as it is essential that all signs at the worksite or varied travel route accurately represent the prevailing conditions at all times.

Static signs used for mobile works

Temporary static signs not mounted on vehicles, must be installed in accordance with the requirements of AGTTM Part 3.

Signs must be positioned a distance equal to that shown in Table 2.2 from the worksite or hazard. Subsequent signs (after the sign closest to the worksite) must be placed a distance equal to the distances listed in Table 2.2.

There is a tolerance on all distances which is 10% less or 25% more than the distances listed.

Table 2.2: Sign spacing

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

2.5.4 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.

2.5.5 Traffic volume

Traffic volumes form a key input to the design of a TGS, aiding the 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 undertake mobile works 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.

When higher than anticipated traffic volumes occur at a site, the TGS should be re-evaluated and an alternative plan created to avoid 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 traffic speed? Is a detour required?)
- 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 on 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.

2.5.6 Speed

All references to speed are the posted speed (temporary or permanent) unless the speed of traffic is substantially higher or lower (greater or less 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. Traffic speeds must be monitored throughout the completion of works to ensure compliance with AGTTM.

2.5.7 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 the following:

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

3. TGS Design for Mobile Works

3.1 General

Mobile works involve vehicles moving progressively along the roadway at speeds lower than that of general traffic. This may be on the road or on the shoulder. Work activities which require the mobile works convoy to stop in traffic for less than one hour at one location may be treated as either mobile works or frequently changing or constantly moving works in accordance with AGTTM Part 5.

While this Guide provides information for contractors, road authorities and labour crews to ensure they are undertaking works safely, any contractors completing mobile works are obliged to comply with current road regulations and jurisdictional requirements.

This guidance will assist the designer with the development of a TGS. The TGS will include appropriate control measures and devices to warn, instruct and guide road users how to safely negotiate the worksite (including footpaths, shared paths and bicycle paths adjacent to the roadway).

3.2 Activities

There are three classes of activities in which mobile works can be completed where vehicles may obstruct or partially obstruct traffic lanes. If works are not considered within Class 1, they may be identifiable in Class 2. Any vehicles used during a mobile work convoy, must be at least the size of a standard utility vehicle.

3.2.1 Class 1

Vehicles undertaking works travelling within 20 km/h of the permanent speed limit may undertake works without the use of protection (e.g. work vehicles travelling at 80 km/h in a 100 km/h speed zone or 40 km/h in a 60 km/h speed zone). Works in this category should be undertaken as per the Constantly moving worksite practices outlined in AGTTM Part 5. Examples include but are not limited to:

- data collection vehicles
- road inspections
- monitoring traffic counts
- pavement testing.

3.2.2 Class 2

Vehicles undertaking works travelling greater than 20 km/h below the permanent speed limit (e.g. work vehicles travelling at 70 km/h or less in a 100 km/h speed zone or 40 km/h in a 70 km/h speed zone) (i.e. no workers on foot). Vehicles are required to be at least the size of a standard utility vehicle. Examples include:

- linemarking using ride-on plant, self-propelled, towed or pushed
- operation of pavement test vehicles
- raised pavement marker installation
- pavement sweeping
- pavement testing
- road inspections
- snow clearing/spreading grit
- shoulder grading
- vegetation control (mowing and spraying).

3.2.3 Class 3

Works involving activities completed on foot. Examples include but are not limited to:

- linemarking using ride-on plant, self-propelled, towed or pushed
- raised pavement marker installations
- pedestrian type linemarking and pavement marker laying or removal where a shadow vehicle is used.

For shoulder grading, pavement and edge patching, or other works involving workers on foot, a works convoy may be suitable.

3.3 Step 1 – Confirm the Works can be Defined as Mobile Works

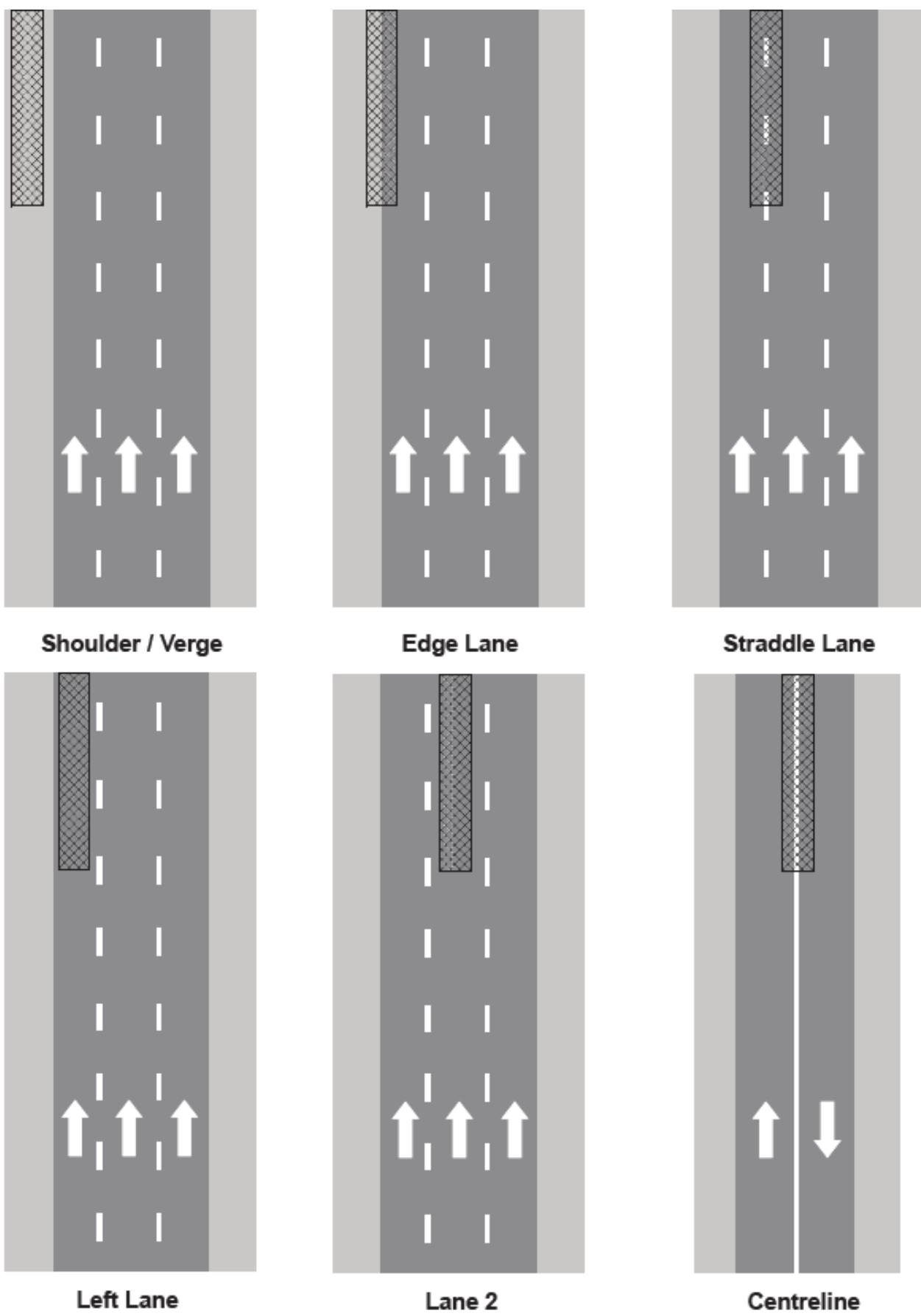
Determine whether mobile works are an appropriate traffic management measure by answering YES to all of the questions below. If this not achievable, see AGTTM Part 3.

1. Can works be completed using a mobile works operation?
2. Is there clear sight distance to the vehicle mounted warning device for approaching drivers (based on the permanent speed limit that includes speed limits displayed on ITS fixtures and devices displayed on motorways)? (see Section 2.5.2)
3. Is the vehicle mounted warning device clearly visible (not obscured) to all road users including pedestrians, cyclists and other vulnerable road users?
4. Are all resources for the mobile works available (including a shadow vehicle)?

3.4 Step 2 – Identify the Works Location

Identifying the lateral location of the works is important to ensure appropriate safe work methods and practices are applied for the works undertaken. The location of the works will be determined by the type and scope of activities undertaken (e.g. pavement sweeping, road inspections). Figure 3.1 outlines the lateral location the works.

If the lateral location of the works involves side streets, signalised intersections, freeway on-ramps or off-ramps, additional planning may be required to manage traffic at these intersections/locations. See Section 3.7.5.

Figure 3.1: Lateral location of work

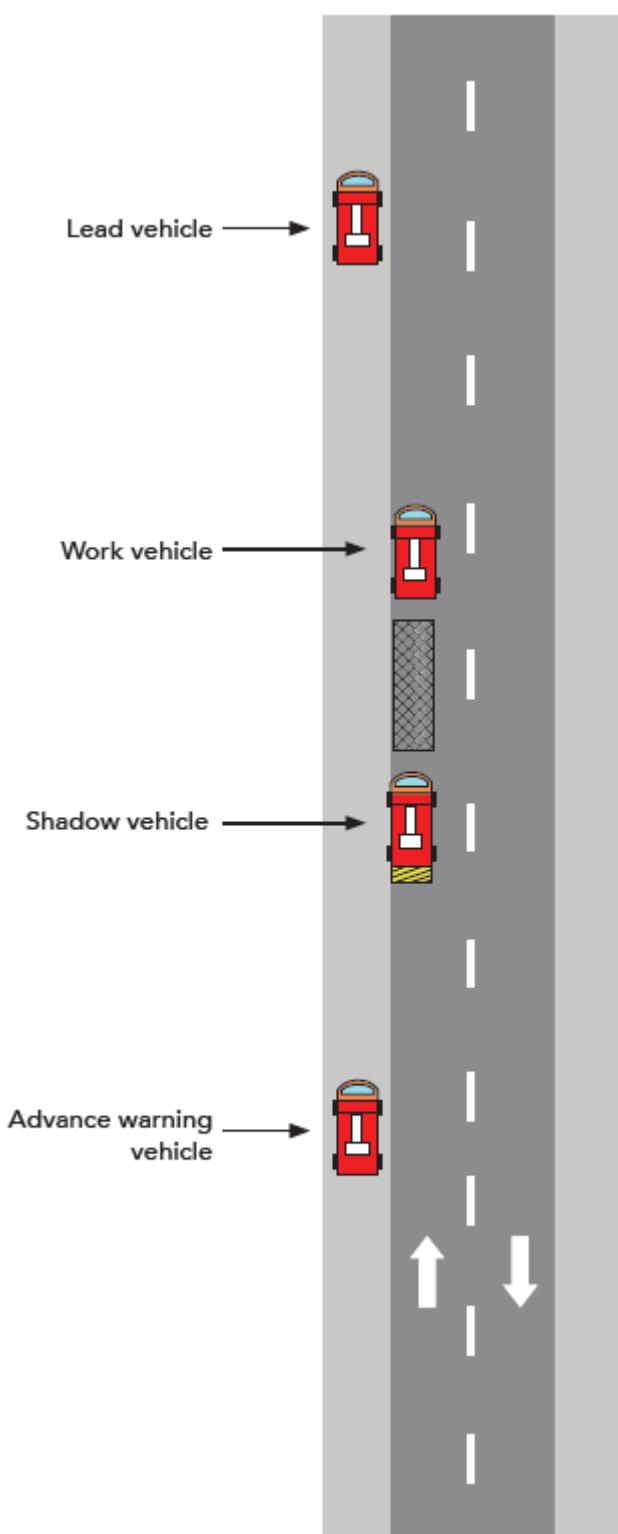
3.5 Step 3 – Determine the Needs of the Works Convoy

A works convoy is made up of a number of specific vehicles. All vehicles within a mobile convoy must be task specific and must only undertake one task at a time (e.g. a work vehicle/s cannot act as an advance warning vehicle at the same time). However, the tasks of vehicles may be rotated. When vehicles are rotating tasks, ensure all activities have stopped while rotation is occurring, and to maintain safe working space road workers must not be located between vehicles or signs. For vehicle rotation on high risk roads (e.g. Category 3, traffic speeds above 80 km/h) a truck mounted attenuator (TMA) must be used for the protection of all vehicles. During the rotation of vehicles, all objects on the vehicles must be secure.

When setting up the work convoy, rear-mounted signs should be placed on vehicles indicating the type of activities occurring. This provides advance warning to road users, enabling them to perceive and process the type of works taking place ahead. All vehicles must be fitted with a vehicle mounted warning device with their location appropriate to the scope of works being undertaken. The use of advance warning to road users does not apply to the work and shadow vehicles when works are not occurring in a traffic lane. When the permanent speed is less than 65 km/h, the implementation of a short-term low impact worksite (AGTTM Part 5) may be considered.

A typical illustration of the vehicles within a works convoy for Class 1 and Class 2 activities and their placement is shown in Figure 3.2.

Figure 3.2: Work convoy layout on a two-way carriageway



Note: This figure depicts only the work convoy layout and does not show any of the required sign, flashing arrow boards or any other devices required.

3.5.1 Lead vehicle

A lead vehicle is responsible for leading work vehicles through the worksite. A lead vehicle must be required for works located:

- on undivided two-way roads
- when there are workers on foot or pedestrian type line marking activities are undertaken
- for ride-on line marking activities.

A lead vehicle provides advanced warning for road users travelling in the opposite direction to a mobile operation, allowing them to react and slow or stop their vehicle before reaching the work vehicles or hazard if required. Where sight visibility is obstructed, the lead vehicle must be advanced further ahead of the work convoy to achieve clear view. When a lead vehicle is in operation, lead vehicles must reinstate the posted speed limit for the direction of the mobile works.

A lead vehicle may not be required on one-way roads, divided roads, for snow clearing or for ice gritting operations.

3.5.2 Work vehicle

A work vehicle is responsible for carrying out an activity adjacent to the road, on the road, or supporting workers on foot who are located between the shadow vehicle and the work vehicle. Where possible, minimise delays to traffic when work vehicles are in operation. When there are workers on foot, and there is no lead vehicle, work vehicles must reinstate the posted speed limit. Work vehicles are not designed to protect the workers. Examples of work vehicles include, but not limited to:

- large item of plant (road marking vehicles, snow plough and graders)
- traffic cone pick-up vehicles
- road survey vehicles
- mowing vehicles
- street cleaners
- TTM equipment vehicles
- sweepers.

When a mobile operation contains more than one work vehicle (and there are no workers on foot), each work vehicle should be 40 m apart as a maximum. If this is not practicable, each work vehicle must be treated as a separate mobile operation with their own work convoy.

3.5.3 Shadow vehicle

A shadow vehicle is required to provide close protection to the rear of workers on foot and work vehicles regardless of works location or speed of traffic. If a shadow vehicle is not available, a static worksite (see AGTTM Part 3) must be implemented. The driver of the shadow vehicle must remain in the cab of the vehicle while part of a mobile operation. When the shadow vehicle is in a stationary position, the driver may be removed from the cab in accordance with Section 3.8.6.

If a shadow vehicle is the first vehicle on site for a Category 2 road with a posted speed limit of 80 km/h or greater, then the vehicle should be fitted with a TMA. The shadow vehicle must be fitted with a TMA for works on Category 3 roads. A shadow vehicle must be required for activities such as shoulder grading, pavement and edge patching, and other works where workers are required to be on foot. If a shadow vehicle is unavailable, implement a static worksite (See AGTTM Part 3).

For protection of workers on foot or small plant items, the shadow vehicle must follow 40 m behind in the work lane. A temporary speed limit must be applied to reduce speeds to 40 km/h or less (see Section 3.8.4 and AGTTM Part 3).

For a shadow vehicle operating with large plant items, where no workers on foot or small plant are present, the shadow vehicle must follow 40 m behind in the lane/shoulder to the left of the work lane. If this is not practicable, the shadow vehicle should follow in the work lane.

In all scenarios with workers on foot, small items of plant or large plant items, if mobile works come to an intersection, on/off ramp, or side road, the shadow vehicle should be moved closer to compensate for turning traffic. Once the intersection, on/off ramp or side road has been passed, the shadow vehicle must return to its previous spacing distance (See 3.7.5).

Regular monitoring of these distances must be undertaken to ensure safety of road workers is maintained. If a shadow vehicle is too close to the work area and is hit from behind, the vehicle is in danger of entering the work area and impacting workers on foot. If the shadow vehicle is too far from the work area, the risk of road users entering the area between the shadow vehicle and work area is increased.

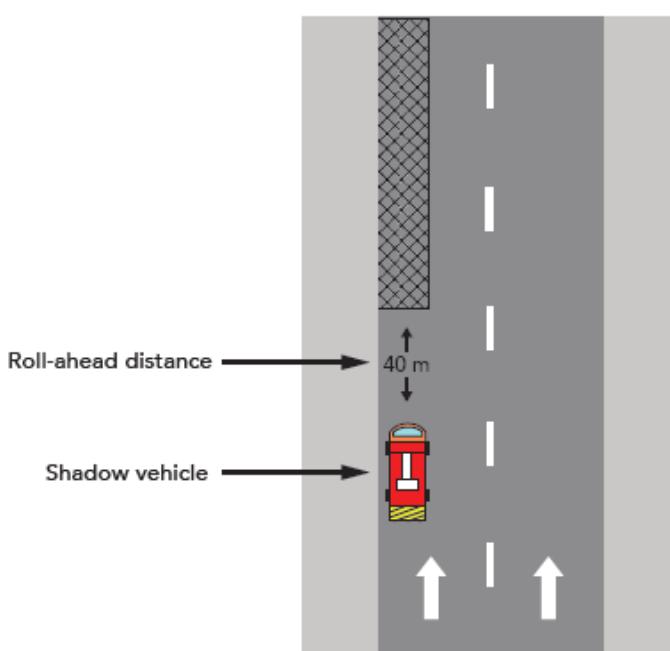
Truck mounted attenuators

TMA^s are often used with shadow vehicles to protect the worksite and reduce the impact for the road user. They are a safety device designed to reduce the severity of collision from any errant vehicles causing harm to road workers. As such, the first shadow vehicle on site is the vehicle fitted with a TMA. When there is more than one shadow vehicle used on a Category 3 road, subsequent shadow vehicles should also be fitted with a TMA.

On Category 3 roads, a TMA must be used when road closure or temporary safety barriers are not practicable. On Category 2 and Category 1 roads, a TMA may also be required if a risk assessment determines that it is necessary. If a TMA is required but not available, implement a static worksite (see AGTTM Part 3).

Shadow vehicles with a TMA must follow 40 m behind workers on foot and plant as detailed shown in Figure 3.3. This allows a safe roll-ahead distance for vehicle movement if impacted, hence, no road workers or plant are permitted in this exclusion zone.

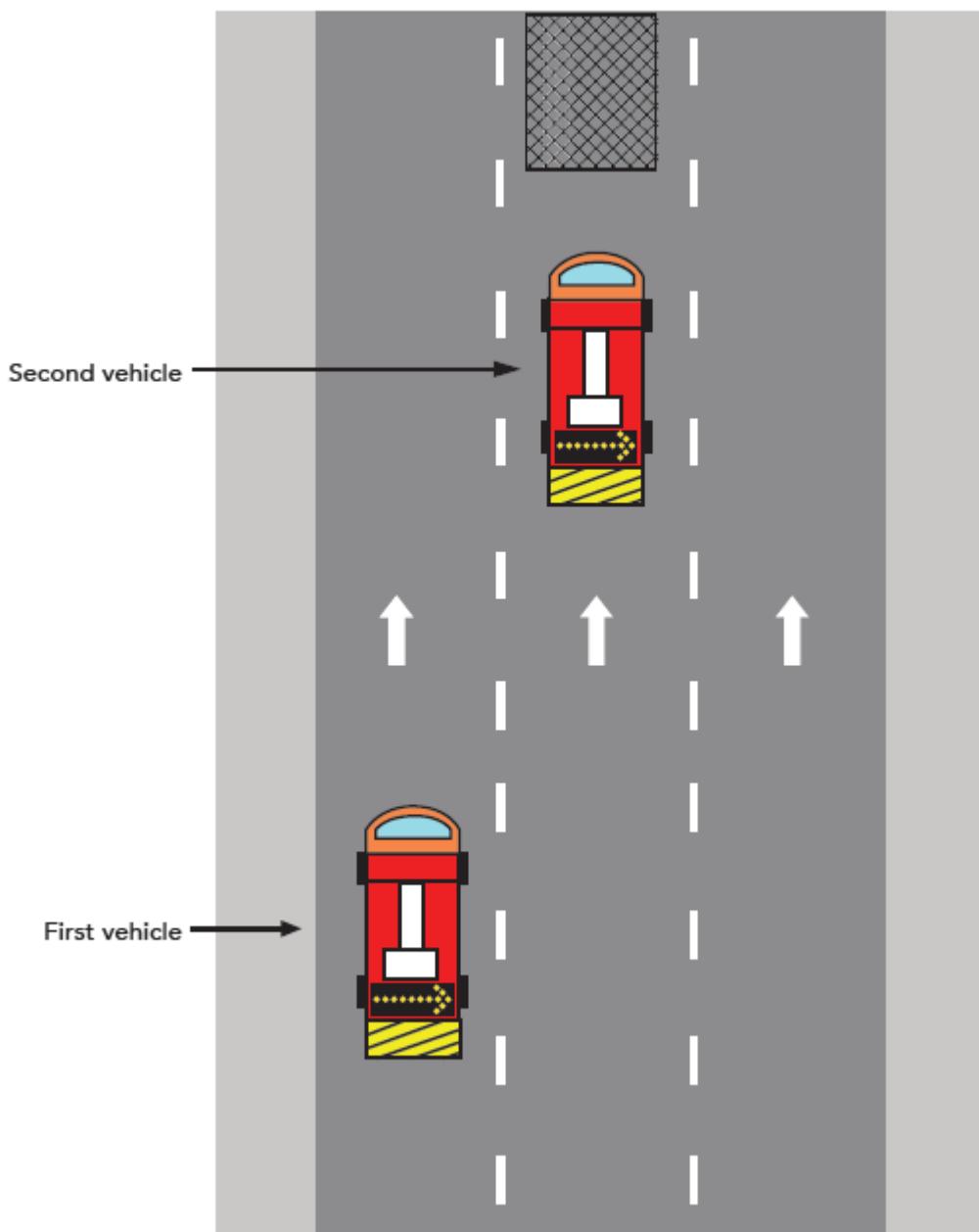
Figure 3.3: Shadow vehicle positioning



Category 3 roads may deploy two or more shadow vehicles with TMAs depending on the location of works (e.g. multiple lane closure with multiple shadow vehicles). The arrangement of the vehicles must be to form a mobile taper with the first vehicle travelling to the left or right of the occupied lane and the second travelling in the occupied lane. Subsequent lanes are to be closed in a staggered manner with other shadow vehicles. This is illustrated in Figure 3.4.

If a TMA is not available for works on a Category 3 road, implement a static worksite (see AGTTM Part 3).

Figure 3.4: Deployment of TMA



3.5.4 Advance warning vehicle

An advance warning vehicle provides advance warning to road users coming up behind mobile works and diverting traffic past the worksite. As such, a clear sight distance must be provided from approaching road users to the advance warning vehicle (see Section 2.5.2). An advance warning vehicle can also display speed signs to provide speed decrease increments and display the lane status to road users. When the speed limit is reduced by more than 20 km/h, consider the use of multiple advance warning vehicles to decrease speed in steps. Advance warning vehicles must be stopped along curved sections of road or where visibility is restricted to maintain sight distance. The driver of the advance warning vehicle must alert road workers, especially workers on foot, to any interruption, hazard or approaching danger.

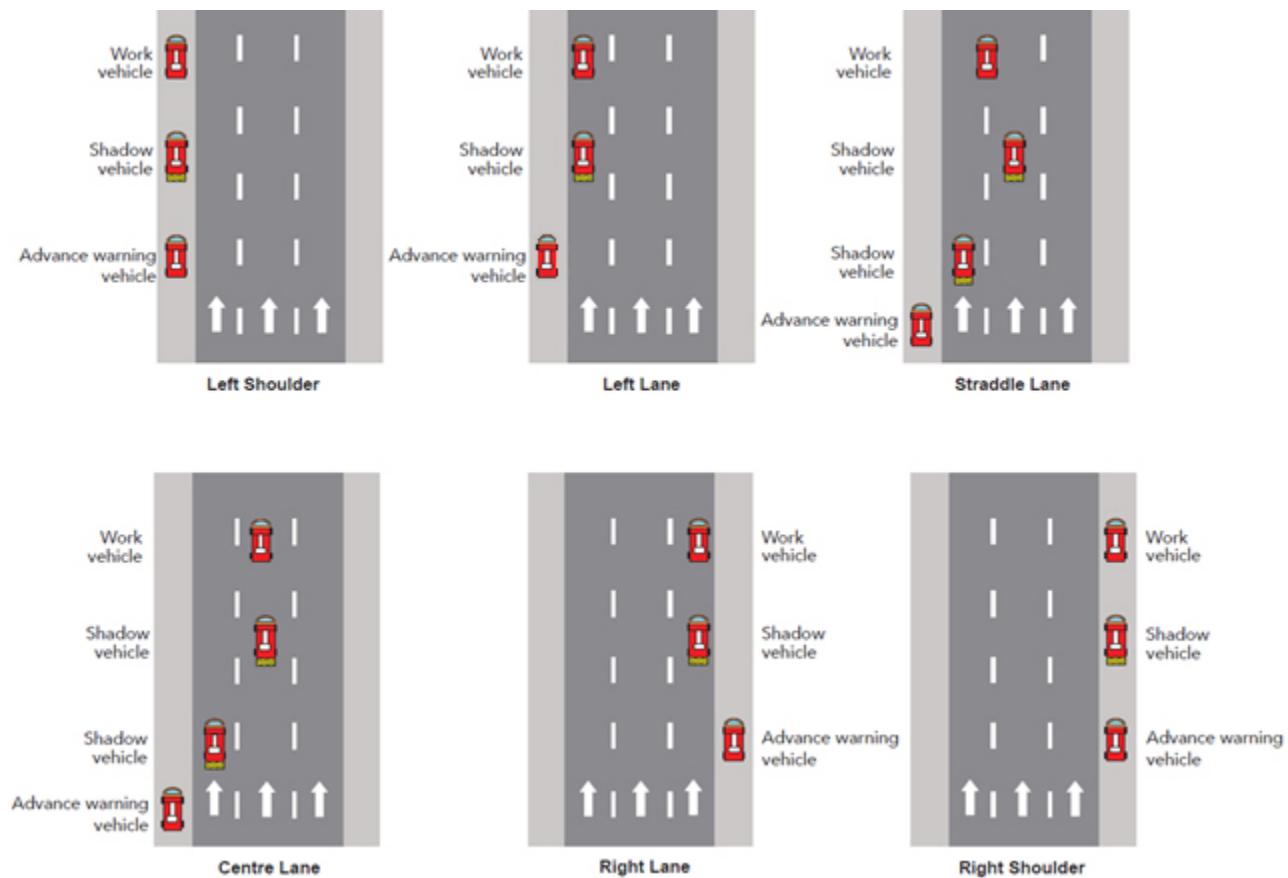
Where possible, based on the activities undertaken, the advance warning vehicle should be positioned as far to the left (or right if works are on the right side of the road) of the worksite as practicable. This can include positioning the advance warning vehicle on the shoulder and ensuring the advance warning vehicle is clear of traffic lanes where possible. This reduces disruption to road users.

The use of ITS devices may be advisable to provide information regarding the decrease in speeds, if available, following a risk assessment and review of the worksite location and duration of works. Where ITS devices are unavailable, the decrease in speed will be positioned on the advance warning vehicle to inform drivers of upcoming operational conditions.

3.5.5 Vehicle positioning

To assist with the selection of vehicles required for works, Figure 3.5 illustrates the position of vehicles undertaking works at a mobile worksite.

Figure 3.5: Vehicle positioning



3.6 Step 4 – Determine the Works Convoy Spacing

The longitudinal spacing of the works convoy is important when ensuring the safety of road workers and road users. This guidance on spacing is specific to the distance between the shadow vehicle and advance warning vehicle, and distance between the lead vehicle and work vehicle. The shadow vehicle must travel 40 m behind the work vehicle (see Section 3.5.3) or workers, whichever is closer.

When determining distances between convoy vehicles consider:

- geometric alignment
- road user behaviour
- traffic volume
- speed of traffic
- sight distance.

More than one shadow vehicle must be used when there is low visibility on site and the required visibility between vehicles cannot be achieved. The recommended distances between convoy vehicles is shown in Table 3.1. These are based on the sight stopping distances for trucks extracted from the Austroads Guide to Road Design Part 3. When undertaking linemarking activities, the spacing of vehicles may be extended to protect the linemarking.

Where the sight distance is poor:

- move the lead vehicle beyond distances shown in Table 3.1 to a point where clear sight distance is achieved
- keep the advance warning vehicle stationary until the work vehicle has travelled ahead to a point where clear sight distance is achieved.

Table 3.1: Spacing distances between vehicles in mobile works (excluding the shadow vehicle to work vehicle)

Speed (km/h)	Distance between convoy vehicles (m)
≤ 45	50
46 - 55	70
56 - 65	90
66 - 75	110
76 - 85	140
86 - 95	160
96 - 105	200
≥ 106	230

A visual representation of convoy vehicle spacing for works on a shoulder is shown in Figure 3.6. For this example, the distance between the shadow vehicle and advance warning vehicle is based on a traffic speed of 70 km/h.

A visual representation of convoy vehicle spacing for works in the left lane is shown in Figure 3.7. For this example, the distance between the shadow vehicle and advance warning vehicle is based on a traffic speed of 60 km/h. A risk assessment has determined a TMA is required on the shadow vehicle.

A visual representation of convoy vehicle spacing for works in the centreline on a two-way road is shown in Figure 3.8. For this example, the distance between the shadow vehicle and advance warning vehicle is based on a traffic speed of 100 km/h. A risk assessment has determined a TMA is required as the shadow vehicle.

Figure 3.6: Plant and vehicle spacing on the shoulder with traffic speed of 70 km/h

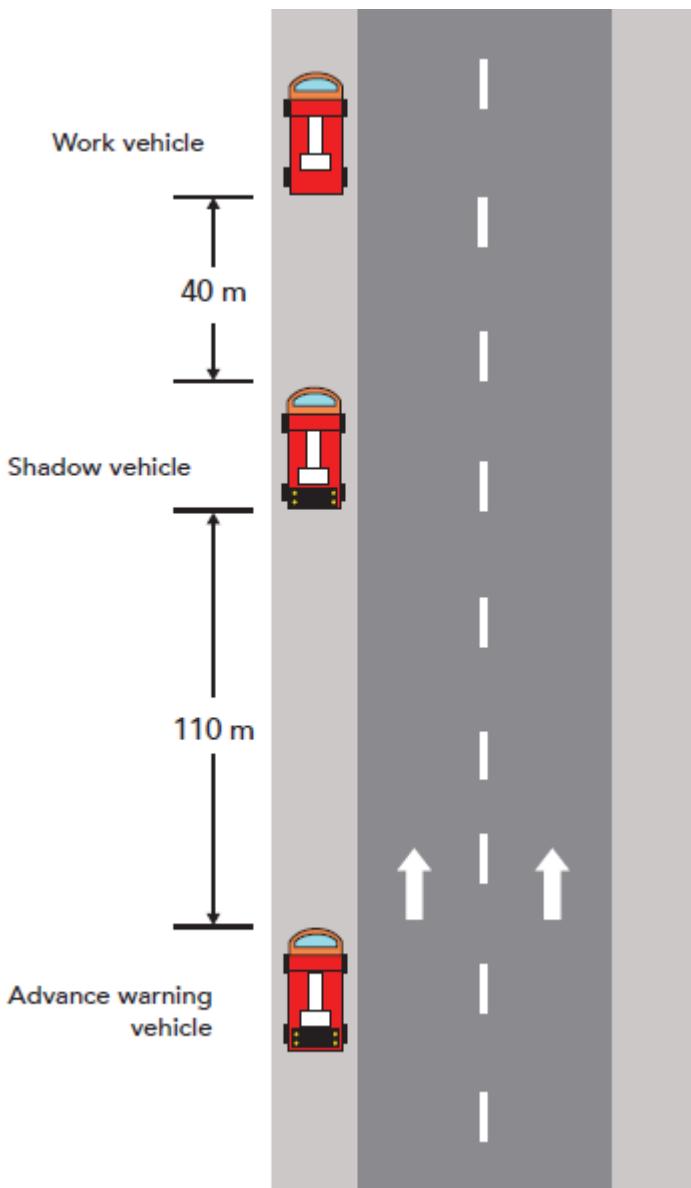


Figure 3.7: Plant and vehicle spacing in the left lane with a traffic speed of 60 km/h

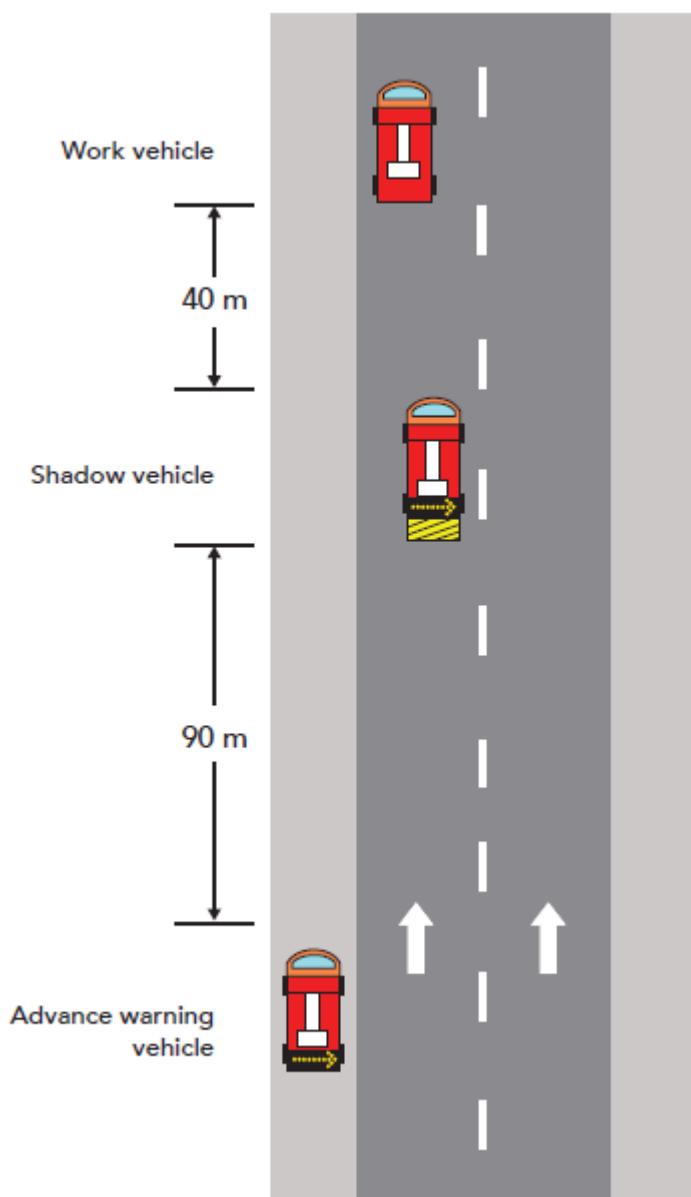
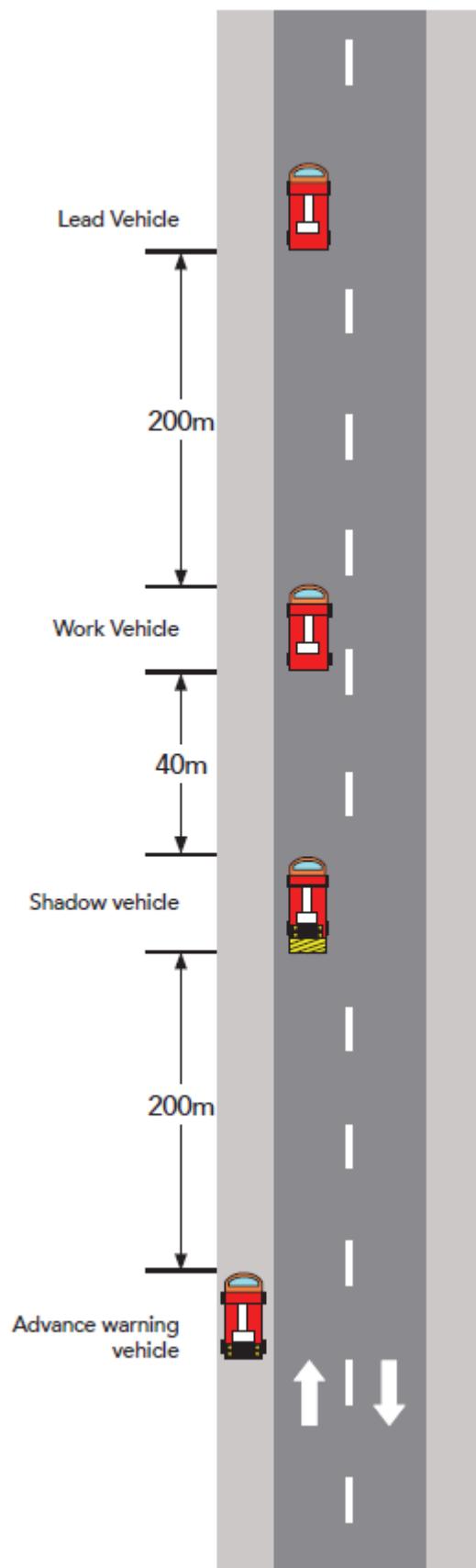


Figure 3.8: Plant and vehicle spacing for works on a two-way road at traffic speed of 100 km/h



3.7 Step 5 – Determine the Signs and Devices to Use

Signs are important to ensure the safety of road workers and road users during works. Where appropriate, all signs required for works must be attached to the convoy vehicles. This includes temporary speed limit signs (where permitted by the relevant road authority). Any signage that is not within the AS 1742 series needs to be approved by the relevant authority before it can be implemented on the road.

The location of advance warning signs and devices varies according to:

- sight distance (see Section 2.5.2) and obstructions
- the speed of traffic
- the scope of works
- any travel diversion.

If the signs are not available for the duration of the works, then alternative work methods such as a static worksite (see AGTTM Part 3), needs to be established.

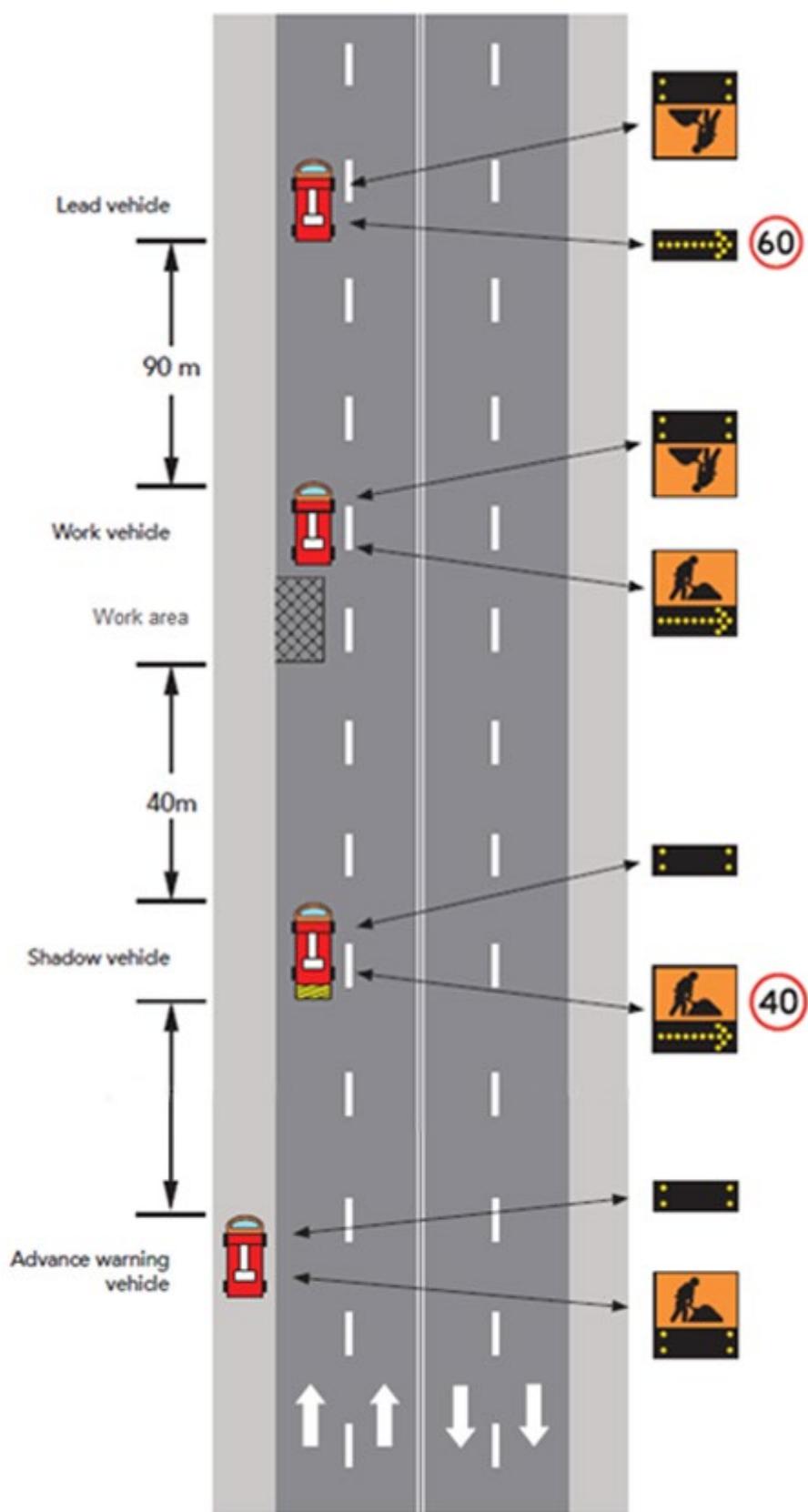
3.7.1 Advance warning

Appropriate advance warning signs must be displayed on the advance warning vehicle while works are being undertaken. If works are on two-way roadways, an advance warning sign must be displayed on the lead vehicle also for road users approaching from the opposite direction. For example:

- Workers (symbolic)
- LINEMARKING
- Speed Restriction sign
- ROAD WORK.

Figure 3.9 illustrates the use of the appropriate signs to use where workers are on foot and convoy vehicle spacing at traffic speed of 60 km/h. Where possible, the advance warning vehicle is to be positioned in the shoulder and where sight distance is restricted, the advance warning vehicle is to stop and increase the spacing between the vehicles. Advance warning (such as speed limits) can also be illustrated on ITS fixtures and devices displayed on motorways with the approval from the relevant authorities.

Figure 3.9: Advance warning signs and vehicle spacing for traffic speeds up to 60 km/h



Note In this example, a risk assessment has determined that a TMA is required on the shadow vehicle due to the presence of workers on foot with the work vehicle and within the traffic lane

3.7.2 Signs mounted on vehicles

Signs will indicate the type of work being completed and provide additional warning of the presence of workers on foot when required. Multi-message signs may be used on the vehicles.

Vehicle mounted warning devices fitted with illuminated arrow signs must be fitted to all convoy vehicles and plant items. This excludes small plant items protected by a work vehicle and shadow vehicle. The sign mounted to the vehicle and illuminated flashing arrow sign must be the minimum size of:

- 1260 mm x 650 mm mounted on the roof on a light vehicle
- 1500 mm x 770 mm mounted on the cab of a truck
- 2400 mm x 1200 mm mounted for trailers (with an independent power supply) or mounted on the cab of a truck.

Lighting requirements on vehicles must ensure:

- lamps must be shielded to ensure the sign displayed is not visually disrupted or distorted
- flash the four corner lights of the arrow, or alternatively the bar of the arrow, when the sign is used as a general warning device
- flash the bar and head of the arrow when the sign is used to direct traffic to pass to a side of the vehicle (see AS1742.3 Clause 4.14.2 for further details).
- the Workers (symbolic) sign or LINEMARKING sign can also be used as vehicle mounted warning devices with an illuminated flashing arrow.

Traffic signs attached to the vehicles must:

- be the approved size
- have a retro-reflective fluorescent background (unless specified otherwise)
- be positioned so that the longitudinal axis is at right angles to the centreline of the vehicle (\pm five degrees)
- be mounted to be clearly visible to all approaching road users.

In addition, consider attaching a supplementary plate with the appropriate advance warning sign to advance warning vehicles.

Signs and devices not being used during works must be removed, covered, folded or deactivated. This ensures the signs and devices are not visible and do not cause any confusion to road users.

Vehicle mounted warning device

All vehicles and items of plant in the mobile works convoy, other than minor items of plant protected by a works vehicle and shadow vehicle must carry a vehicle-mounted warning device fitted with an illuminated flashing arrow sign.

These are used to increase road worker safety and alert road users of any plant, equipment or vehicles in operation. The sight distance from approaching road users to the vehicle mounted warning device is 150 m for traffic speeds 60 km/h or less, and 250 m for traffic speeds greater than 60 km/h.

To increase safety, use flashing lamps on vehicles which provides visibility in all directions. When using a flashing lamp consider:

- keeping it turned on at all times during mobile operation
- keeping it turned on and operational until vehicles are safely within the work area, or until they have reached a speed similar to other vehicles on the road when exiting a work area

- turning it off when the vehicle's hazard lights are turned on and the vehicle is within the work area, clearly separated from traffic lanes by delineation devices (see AGTTM Part 3).

Variable message sign

A variable message sign is predominately used on an advance warning vehicle. Where and when it is safe to do so, the vehicle mounted with the VMS may be driven slowly along the shoulder (or median as appropriate) or join the traffic flow and travel forward to the next warning location whilst maintaining its position with the mobile convoy ahead. The VMS must be operated from within the vehicle on all road categories and must not be left unattended.

3.7.3 Works within a shoulder

If appropriate sight distance is available for an activity being completed within the shoulder, the following measures must be used:

- display a ROADWORK AHEAD sign and any other relevant signs in advance of the worksite
- attach a vehicle mounted arrow board to the work vehicle(s) with a line bar or four corners lights only
- display an END ROADWORK sign at the end of the worksite on the last vehicle
- display the Worker Symbolic sign or ROAD PLANT AHEAD sign respectively when either workers on foot or plant items alone are working
- if this is not practicable, implement a static worksite (see AGTTM Part 3).

If appropriate sight distance is not available for the activity being completed within the shoulder, the following measures must be used:

- display a ROAD WORK AHEAD sign and any other relevant sign displayed in advance of the worksite
- a vehicle mounted arrow board must be mounted on the work vehicle(s) with a line bar or four corner lights only
- the work vehicle(s) must be fitted with the relevant advance warning signs
- use a shadow vehicle with an advance warning vehicle positioned to allow adequate sight distance for approaching road users
- consider a static lane closure or a risk assessment of the points listed.

For works within a shoulder, parking lane or other lane where parking is permitted:

- attach a vehicle mounted warning device to the advance warning vehicle
- shadow vehicles are not needed for single shift works if:
 - there are large plant items, no workers on foot and a clearance of greater than 1.2 m to the live traffic lane when the speed of traffic is 80 km/h or more
 - there are large plant items that won't encroach onto the traffic lane, no workers on foot and a clearance of less than 1.2 m to the traffic lane when the speed of traffic is less than 80 km/h
 - there are small plant items or workers on foot and the speed of traffic is 60 km/h or less and the work area does not encroach onto a traffic lane
 - there are small plant items or workers on foot and a clearance of more than 1.2 m to the traffic lane when the speed of traffic is between 60 km/h and 80 km/h
 - there are small plant items or workers on foot and the entire work area is at least 3 m clear of the traffic lane.

If a shadow vehicle is not available, appropriate sight distance cannot be achieved to undertake the works safely and the above points cannot be met, implement a static worksite (see AGTTM Part 3).

If the work convoy needs to stop for extended periods (e.g. 1 hour), implement a short-term low impact worksite (see AGTTM Part 5).

3.7.4 Works within a lane

It is recommended that workers on foot do not enter or undertake activities in a traffic lane at any time during the installation, maintenance, or removal of equipment. Road workers may enter a traffic lane when it is necessary to erect a sign, place a delineation device, remove a hazard under exceptional circumstances, and the following:

- enter the traffic lane in accordance with the guidelines set out in the contingency section of the approved TMP
- enter the traffic lane in the quickest and safest manner possible
- enter the traffic lane when using a spotter or lookout person
- apply the practise documented in AGTTM Part 5.

For works within a lane on Category 1 or 2 roads:

- display a ROAD WORKS sign for advance warning
- fit the shadow vehicle with an illuminated flashing arrow
- fit the work vehicle(s) with a flashing lamp and vehicle mounted warning device
- display an END ROADWORK sign at the end of the worksite
- use a lead vehicle on two-way roads when works are in the lane next to the dividing line to provide advanced warning for road users travelling in the opposite direction
- use lane status signs to indicate lane closure ahead for multi-lane roads
- fit the advance warning vehicle with a TMA if the vehicle is in the traffic lane
- undertake a risk assessment to evaluate whether the shadow vehicle(s) requires a TMA as described in Section 3.5.3

For works within a lane on Category 3 roads:

- the shadow vehicle(s) must be fitted with a TMA
- the advance warning vehicle should be fitted with a VMS to give appropriate advance warning to road users
- the work vehicle must be fitted with a vehicle mounted warning device and an arrow board. If works are in the right lane, the arrow board points left.

3.7.5 Works involve side street, signalised intersection, freeway on-ramp or off-ramp

When the length of the mobile works involves a major side street, signalised intersection, freeway on-ramp or off-ramp, a static worksite (see AGTTM Part 3) may be implemented at these locations to ensure turning traffic are safely managed.

When a risk assessment indicates that a static worksite is not required at these locations, the spacing between the vehicles within the works convoy may be reduced temporarily while the convoy is crossing the side street, freeway on-ramp or off-ramp. This is to prevent vehicles from entering or leaving the road in between the convoy vehicles.

3.8 Step 6 – Identify the Operational Procedures to be Followed

3.8.1 Reduced sight distance

Reduced sight distance on a worksite due to horizontal and vertical geometry can impact the safety of workers and other road users. Sight distance is further expanded on in Section 2.5.2. When reduced sight distance is encountered, the advance warning vehicle must be stopped while the other convoy vehicles travel along a curve or section of road with restricted/limited sight distance. Where clear sight distance cannot be achieved within the works convoy, use an additional shadow vehicle or implement a static worksite (see AGTTM Part 3).

If reduced sight distance is due to excessive inclement weather conditions, stop work and remove all traffic management devices from the road in a safe manner.

3.8.2 Signs

Signs implemented must adhere to relevant jurisdictional requirements.

All signs and warning or delineation devices must be attached to work convoy vehicles.

All vehicle mounted signs and devices must be removed or deactivated when the vehicle is no longer part of the mobile works operation and is returning to the normal stream of traffic with other road users.

3.8.3 Advance warning

Appropriate advance warning signs must be displayed on the advance warning vehicle. Advance warning vehicles are not needed for traffic below 60 km/h (e.g. during inspection activities) if the work vehicle is continuously moving and travelling slower than the general traffic and the work vehicle can be parked clear of traffic lanes. On higher speed roads, multiple advance warning vehicles may be used to lower the speed of traffic.

If works are on two-way roadways, in the lane next to the dividing line, an advance warning sign must be displayed on the lead vehicle for road users approaching from the opposite direction. This includes the activity being undertaken and indication of travel path.

On networks of road that have increased volumes of heavy or over-dimensional vehicles including road trains and B-doubles, increase the advance warning sight distance based on a risk assessment.

3.8.4 Mobile temporary speed zone

To improve the safety of road workers and road users, a temporary speed limit of 40 km/h must be applied when mobile works involve workers on foot, when using small ride-on plant within the lane or within 1.2 m of traffic. The only exception is mobile works undertaken outside the lane.

This will improve the safety of road workers and road users. The mobile work zone must be established through the use of a 40 AHEAD sign located on the advance warning vehicle. The work and shadow vehicle must implement a 40 Speed Restriction sign if the speed zone applies to road users travelling in both directions.

For works where a lead vehicle is not required, the speed zone must be placed between the work vehicle (or plant item) and the shadow vehicle.

All temporary speed limits require a risk assessment to determine the appropriate speed limit. If a risk assessment indicates an unusually high risk to workers at a particular site, a speed limit lower than 40 km/h may be required. When workers on foot or using small ride-on plant are no longer within the lane, the temporary speed limit must be removed.

Ensure that the temporary speed zone is terminated by a Speed Restriction or END Speed Limit sign. The END Speed Limit sign will trigger the default built up or open road speed limit.

3.8.5 Workers on foot

A temporary mobile speed zone of 40 km/h must be implemented for workers on foot within the traffic lane or within 1.2m of traffic as in Section 3.8.4. When workers are on foot but are no longer located within the lane or within 1.2m of traffic (e.g. on a shoulder), the temporary speed limit of 40 km/h should be removed.

The time taken for workers on foot to complete their tasks should be kept to an absolute minimum.

Provide all workers on foot that are part of a mobile convoy with a communication device allowing them to communicate with vehicles (e.g. a short-range radio) and receive notification of any approaching danger.

3.8.6 Work convoy arrangements

The driver of the shadow vehicle must remain in the cab of the vehicle while part of a mobile operation. When the shadow vehicle is in a stationary position, it is recommended the hand brake to be applied (with automatic gear boxes in park) or that the vehicle is engaged in low gear. Based on a risk assessment, when the vehicle is stationary for times longer than 10 minutes it is recommended the driver be removed from the cab when it is safe to do so (assuming the shadow vehicle is in a safe stationary position). For short periods (e.g. less than 10 minutes) of stationary vehicles, there may be additional risk of the driver exiting and re-entering the cabin.

The driver of a TMA must remain in the cab of the vehicle while part of a mobile operation. When a TMA is in use, a safety harness must be used by the driver at all times.

Drivers of shadow, lead and advance warning vehicles are required to be alert to all approaching vehicles, and any hazards approaching the site, so are not to perform functions other than driving the vehicle while part of a mobile operation. All vehicles within a mobile worksite are required to be task specific and must only undertake one task at a time (e.g. a work vehicle/s cannot act as an advance warning vehicle at the same time).

3.8.7 Maintaining traffic flow

Traffic controllers must not be used for mobile works to maintain traffic flow. If works require the use of a traffic controller, implement a static worksite (see AGTTM Part 3).

To maintain traffic flow on two-way roads:

- consider avoiding work during peak periods
- do not reduce the overall width of the lane of traffic to less than what is required for the safe passage of vehicles (including heavy or over-dimensional vehicles)
- traffic may be permitted to overtake partially into the path of oncoming traffic when working on lane or edge line and within the lane to the left of the work vehicle and shadow vehicle where safe and practical to do so. This is governed by the use of vehicle mounted arrow boards. Arrow boards are only used on multi-lane roads where merging into another lane is safe. Hazard lights are used when drivers need to choose when to overtake safely. Partially is defined as sufficient width for an overtaking vehicle to pass an oncoming vehicle if there is an emergency.
- display the bar or four corner lights of the illuminated flashing arrow only to indicate a hazard ahead
- provide opportunities for traffic to pass works on the dividing line or lane line by stopping the work convoy and widening the available roadway and shoulder temporarily
- do not direct traffic across a dividing line into the path of oncoming traffic
- do not direct traffic across the path of freshly marked lines that result in the new line being damaged.

To maintain traffic flow on Category 3 roads, deploy a second advance warning vehicle to form a mobile taper. The first vehicle (closest to the work vehicle) will travel in the occupied lane. The second vehicle travels to the left (or the right) of the occupied lane closest to the kerb.

For mobile closures required in the centre lane on a multilane or a one-way road, the shadow vehicles are required to close the lane in a staggered manner starting on the left in the same configuration as Figure 3.4 and Figure 3.5. If the centre lane is required to be closed, additional shadow vehicles will be required.

3.8.8 Communication

A communication system must be used with a consistently available channel, appropriate to the work environment. The site supervisor must ensure all facets of the mobile operation and the drivers of vehicles have continuous communication at all times.

Cellular phones do not provide instantaneous communication and effectiveness can be influenced by service coverage limitations. Use portable two-way radios or similar devices for communication.

All workers on foot or operators of plant that are part of a mobile convoy must be provided with a communication device allowing them to communicate with vehicles and receive notification of any approaching danger.

3.8.9 Pedestrians and cyclists

Where mobile works affect pedestrians and/or cyclists, TTM measures must ensure that:

- pedestrians with impaired vision, mobility, hearing or cognitive limitations are considered as part of the design, preparation, approval and implementation of TTM
- pedestrians or cyclists are not led into direct conflict with the mobile operation or other moving traffic
- if cyclists or pedestrians are directed into lanes carrying traffic they are adequately protected
- safe and obstruction free temporary paths are provided where footpaths, bicycle lanes or roads used by public transport are blocked by the activity.

If mobile works cannot appropriately cater for pedestrians and cyclists consider the implementation of a static worksite or the implementation of pedestrian and cyclist traffic management, such as a detour in AGTTM Part 3.

3.8.10 Road marking & line marking

To protect new road markings, traffic cones with a minimum height of 450 mm must be used. Cones may be used up to a maximum height of 900 mm for road marking and line marking operations. Traffic cone requirements and spacings are provided in AGTTM Part 3, Table 5.3.

Where traffic cones are used to protect line markings, the use of a separate work convoy must collect the traffic cones as soon as they are no longer required.

3.8.11 Kerbside collection and street sweeping

The following requirements for kerbside garbage and recycle collections should be considered:

- equip all vehicles with a vehicle mounted warning device
- operate all vehicles in accordance with the relevant jurisdictional traffic legislation and local government practice
- review any generic TMP yearly and keep the approved TMP in the work vehicle at all times
- install one flashing lamp at the front and two flashing lamps at the rear of each vehicle. These lamps are to be installed at the highest, most practical extremes of the vehicle

- appropriate sight distance outlined in Table 3.2 is available to undertake the activity
- activities are undertaken in zones less than 70 km/h, or 80 km/h if the work vehicle can operate at least 1.2 m or more from traffic.

Table 3.2: Sight distance for kerbside collection

Speed (km/h)	Distance (m)
≤45	10
46 - 55	25
56 - 65	70
≥66	Equal to speed of traffic (km/h)

3.8.12 Rolling blocks

Rolling blocks are typically carried out on Category 2 and 3 roads. This activity is used to clear the road ahead when assisting with the transportation of heavy equipment and machinery into the worksite or undertaking activities such as setting bridge beams, placing overhead sign structures or pulling wires or cables across the roadway. Rolling blocks can be implemented if delay calculations indicate that any queues forming during a rolling block will readily dissipate once the block has finished. This requires special traffic engineering analysis.

Provide initial advance warning (e.g. advance warning vehicle with a VMS) of rolling blocks located 1km in front of the estimated back of queue, which can be supplemented by an overhead gantry VMS where available. Just prior to the back of the queue, an additional advance warning vehicle should be placed in the shoulder, monitoring any behaviour at the end of the queue and notifying the other advance warning vehicles where required.

Control traffic on all on-ramps into the area of the rolling block. These control methods will be implemented through ramp closures which may include traffic signals (see AGTTM Part 3).

When conducting rolling blocks also consider that:

- the rolling block is completed in conjunction with an approved TMP for the activity
- delay calculations should be undertaken to ensure the rolling block does not result in excessive queues
- vehicles with TMAs must keep moving forward at all times. The speed of these vehicles will depend on the works being undertaken.

3.8.13 Unsealed roads

General

Unsealed roads are usually classified as Category 1 roads. Road classifications are outlined briefly in Section 2.5.4. A detailed description of road classifications can be found in AGTTM Part 8.

The following treatments are permitted on unsealed roads in recognition of the fact that these roads generally have lower volumes and traffic speeds when compared to sealed roads. As these roads can be seen to have a partial relaxation of TTM requirements, a detailed risk assessment must be made of the proposed adoption of these treatments, taking into account factors including:

- traffic speed and volume
- road geometry
- road width

- surface condition
- road user behaviour.

These treatments are not to be applied to any road which would normally be sealed but has been left unsealed temporarily or permanently due to, for example:

- economic factors
- climatic factors (adverse weather)
- currently under construction or reconstruction.

Maintenance grading and resheeting

Maintenance grading and resheeting may be carried out either with or without leaving a windrow as indicated. Work completed without leaving a windrow normally involves the use of either a windrow eliminator or a second grader in tandem. Wherever practicable, grading on the right side of the road against oncoming traffic should be avoided.

Maintenance grading and resheeting are to be completed under the following principles:

- the grader must always operate while leaving room for opposing traffic to pass it without driving off the roadway
- the sight distance of the grader's vehicle mounted warning device must be 250 m through the entire section of roadworks
- no advance warning signs for either direction of travel is required.

If all the above maintenance grading and resheeting conditions cannot be met, the work is to be carried out under the following guidelines:

- the maximum length of work that can be completed is 10 km. The sign ROADWORK NEXT 10 km is to be placed at the end of each section
- where sight distance falls to less than 250 m, the following signs must be implemented 100 m in advance of any windrow:
 - GRADER AHEAD or ROAD PLANT AHEAD
 - NEXT 2 km at the end of each subsection (2 km is the maximum distance operations can be undertaken with reduced sight distance)
 - sections with less than 2 km are to display signs including speed zone (if used) and end of zone signs at the end of each section
 - if it is difficult to turn the grader around at the end of the 2 km section, it may be extended to the next available turning point (up to 6 km)
- subsections of 2 km or less are to be completed and signs are to be relocated before proceeding with the next section. If the next section has sight distance deficiencies, the above process is used.

The road condition signs are to be placed at various locations if a freshly graded surface has loose material that may present a hazard. The choice of the sign depends on the nature and degree of the hazard. The following signs apply to this situation:

- slippery symbolic sign
- loose Stones symbolic sign
- LOOSE SURFACE.

Where graded or resheeted material cannot be travelled across or through by traffic, the grader is to be instructed to raise the blade as required and move forward a short distance to allow traffic to pass. Once traffic is passed, the grader can return to normal activities.

Short-term partial road closures

The following information applies to the treatment of short-term partial road closures. Advance warning signs may be omitted from the worksite provided all the following requirements are met:

- the vehicle mounted warning device on the work vehicle can be seen by approaching traffic for at least 250 m
- no traffic controller is required, and traffic flow is maintained
- traffic volumes are less than 20 vpd or there is room for two-way traffic past the work area, or both.

Traffic control is required and may be performed by a single traffic controller under the following conditions:

- there is a single lane that does not exceed 50 m in length
- traffic volumes are less than 20 vph
- the traffic controller can see both directions of approaching traffic when stationed at one end of the job.

Where these conditions are not met, the recommended practice is to treat it in the same way as sealed roads.

3.9 Step 7 – Design the Traffic Guidance Scheme and Document the Notes for Field Staff

The output of Steps 1 to 6 result in the generation of a Traffic Guidance Scheme (TGS) relating to mobile works. Within this suite of documents, consider the following:

- coordination with other road work activities
- environmental conditions
- site specific conditions
- worksite access
- staging of works
- location of vehicles and plant
- all distances are in meters
- pedestrians and cyclists
- signage and devices
- illustration of diagrams and figures (no hand sketches)
- monitoring (site inspection and record keeping)
- traffic management plans
- permits approved by relevant government department
- community liaison (public regulation and stakeholder engagement)
- risk assessment and risk management.

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 4: Mobile Works has been prepared to assist with mobile worksites, in accordance with Austroads best practice. It provides general information about the context and components of designing temporary traffic guidance schemes at mobile worksites.

Guide to Temporary Traffic Management Part 4



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