



**Onshore Seismic Survey Traffic Management Plan
Great South Land Minerals Ltd**



**Appendix D:
RPT Road Hazard Management Guide**



Road Hazard Management Guide



Tasmania

DEPARTMENT of
INFRASTRUCTURE,
ENERGY and RESOURCES

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1 Introduction

Road hazard management is an important component of any road design project. Concepts including forgiving roadside design and risk management are important to provide a safe environment for all road users. The intention of this guide is to address road safety elements that focus on "Keeping vehicles on the road" and "Dealing with errant vehicles" on the occasion that vehicles leave the carriageway. This document aims to address many of the issues related to road safety in road design, and direct practitioners to appropriate design standards and practices.

It is expected that most work done with reference to this document will involve maintenance and upgrading of existing roads. While this may limit the road designer's scope for implementing some of the recommendations listed, a comprehensive upgrade project should involve reference to the guides listed in this Document.

2 Keeping vehicles on the road

This section discusses on-road and roadside features aimed at showing drivers the path that a road takes and helping them keep their vehicles in the running lane.

Roads should be designed with the objective of making it as easy as possible for drivers to keep their vehicles on path. This would be straightforward if the landscape always suited the desired path of the road and there were no financial constraints, but this is rarely the case. In reality a road has to be accommodated within the topography in a cost effective way and this may lead to situations that require departures from the standard. In such cases it becomes necessary to provide additional features designed to help drivers follow the line of the road.

2.1 Delineation

Australian Standard AS1742.2-1994, *Manual of uniform traffic control devices, Part 2 – traffic*

control devices for general use and its amendment, AS1742.2-1994/Amendment 1-1997 sets out requirements of all traffic control devices for use on roads other than freeways. It includes sections on signage for intersection and mid-block locations, pavement markings, and appendices on topics such as calculating advisory speeds for curves.

2.1.1 Linemarking (centre line / edge line)

Centre lines

Centre lines should be marked to separate opposing directions of traffic flow on sealed pavements at least 5.5m wide. On pavements narrower than this the provision of centre lines is not usually provided other than where sight lines for overtaking are deficient. Centre lines may be of the following types:

- separation lines – continuous or broken
- barrier lines – either continuous double lines or single continuous with parallel broken line.

Barrier lines should not be used on pavements of insufficient width where it is not practicable for all vehicles to travel on their side of the line.

Edge lines

Edge lines are used to delineate the edge of the travelled lane. The aim of this delineation is both to discourage travel on the road shoulder and to assist drivers to track the edge of the road. Edge lines are particularly helpful on bends and at night. The minimum sealed pavement width on which edge lines should be installed in Tasmania is 6.4m, although narrower pavements may be provided with edge lines in special circumstances where the lines are considered essential. Edge lines must always be used in conjunction with a centre line (see Clause 4.3.5 of AS 1742.2-1994).

Audiotactile line marking

Edge lines can be provided with raised, transverse bars of thermoplastic material placed

at short intervals (see Figure 1). This practice creates edge lines that provide an audible and tactile warning whenever a vehicle tyre runs over them. The intention of the treatment is to alert the driver to the fact that their vehicle is straying onto the road shoulder and thereby give them a chance to take appropriate action before the vehicle leaves the pavement. Audiotactile edge lines should be considered where there is a recorded history of fatigue related crashes, and may be considered on roads prone to fog.

Some international studies on the effectiveness of using such a treatment have shown run-off-road crash reductions of at least 20% (Ligon et al (1985) cited Dravitzki et al 1998). The effectiveness of the treatment in practice would vary according to individual site conditions.

While the noise generated by audiotactile line marking is usually easily audible in normal passenger cars, it is harder to hear in large vehicles such as four-wheel drives, and is often impossible to hear in trucks. The treatment therefore should not be relied upon to provide warning to heavy vehicle drivers.

Audiotactile edge lines are not mandatory but may be of benefit when it is necessary to warn drivers that they are straying off the carriageway. The absolute minimum seal width required for installation of audiotactile edge lines is 6.6m. This is because at least 0.1m of seal is required outside the edge line. Consult AS 1742.2-1994¹, Section 4 for detailed requirements of various types of pavement markings.

It should be noted that while the noise made by audiotactile edge lines can be of help to drivers, it can also be an annoyance to nearby residents. If these devices are to be installed in areas where roads run close to houses, it may be helpful to inform residents of the proposed installation and its expected safety benefits. It is suggested that such edge lines are not used within 200m of residences.

¹ AS 1742.2-1994 is currently under review. If possible this document should be updated to refer to the new standard.



Figure 1: Audiotactile edge lines on a freeway

2.1.2 Raised pavement markers

Raised pavement markers can be used in conjunction with, or sometimes used instead of painted line markings. Section 4.6 of AS 1742.2-1994 discusses the use of non-retro-reflective and retro-reflective raised pavement markers. Non-retro-reflective pavement markers (NRPMs) may be used in conjunction with raised retro-reflective pavement markers (RRPMs) where it is intended that they simulate marked lines, for example, for lane lines on freeways. NRPMs may also be used at intersections to provide drivers guidance when negotiating the intersection.

RRPMs may be used to augment painted lines or instead of painted lines for the provision of lane lines, separation and barrier lines, edge lines and traffic islands and medians. RRPMs are not obscured at night under wet conditions as the retro-reflective panels sit above the surface and are more prominent than reflectorised painted markings (i.e. paint incorporating glass beads for added reflective capability). In addition, they provide an audible and tactile signal when traversed by vehicle wheels.

It should be noted that while the noise made by RRPMS can be of help to drivers, it can also be an annoyance to nearby residents. If these devices are to be installed in areas where roads run close to houses, it may be helpful to inform residents of the proposed installation and its expected safety benefits.

RRPMs should be used to highlight centre line marking on all Tasmanian rural roads that have a sealed width of at least 6.4m. They should also be applied to the centre lines and outside the edge lines on all National Highway routes and on dual carriageways with no street lighting.

RRPMs are used in various colours as follows:

- **White** markers are used to augment lane lines, separation lines, markings at traffic islands and freeway ramp gore areas.
- **Yellow** markers can be used on the right-hand edge lines of one-way carriageways.
- **Red** markers are used where appropriate to augment left-hand edge lines of two-way and one-way carriageways.
- **Blue** markers are used to mark the location of fire hydrants on roads. In this case a single marker is placed near the road centre line opposite the position of the hydrant on that side of the road.

In areas above the snow line there is a risk that raised pavement markers could be damaged by snow ploughs. For this reason it is recommended that orange snow poles be used instead. Snow poles are designed to be high enough to protrude at least 300mm above expected snow drift levels and their orange colour aids visibility in snow.

2.1.3 Guideposts

Guideposts are used to show the edge of the road and enhance the delineation of the road's path for drivers. They should be installed at a uniform distance from the edge of the road and should be fitted with delineators (see Figure 2). On narrower or lower volume roads where there is insufficient road width to mark a centre line,

guideposts may be the only form of delineation provided.

Requirements for the size, spacing and location of guide posts are detailed in Section 3.2.4 of AS1742.2-1994 document. On straight road sections, guide posts should be arranged in pairs at a spacing of 150m, although this spacing may be amended according to conditions outlined in the standard. The standard also specifies the spacing of guide posts on curves, crests, cuttings, bridges and culverts. Guideposts should be installed to be 1m high above ground level and have a white 100mm wide area for at least the upper 300mm of their height. This 100mm wide area should face oncoming traffic and incorporate a retro-reflective delineator.

Requirements for delineators, including details for mounting on guide posts, safety barrier and snow poles, are described in section 3.2.5 of AS1742.2-1994. A red delineator is used for the left side of the carriageway and white for the right side of the carriageway. Delineators should be of Class 1 material (AS/NZS1906.1-1993) or Class 1A (AS1906.2-1981/Amdt1-1988) where maximum delineation is required.

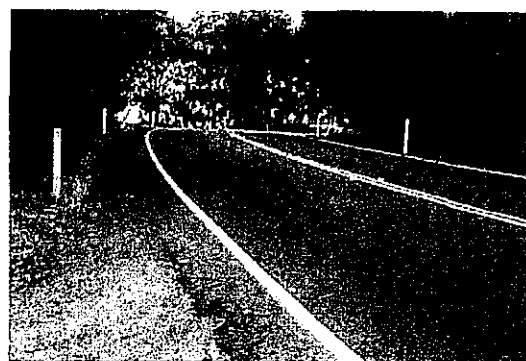


Figure 2: Guide post and retro-reflective delineators providing delineation of a curve

2.1.4 Warning signs

While guide posts and line marking can be used to delineate the path of a road, some of the more unexpected aspects of the road's geometry will require additional signage to convey their severity and nature to drivers.

Curve warning signs, advisory speed signs and chevron alignment markers (CAMs) are all appropriate treatments for substandard curves (see Figure 3). Warning and advisory speed signs should be used in the first instance, with CAMs only installed at locations where other signage is deemed to give insufficient warning. Section 3.4 of AS1742.2-1994 sets out the requirements for various levels of sign provision.



Figure 3: Warning sign, advisory speed sign and chevron alignment markers (CAMs) at a sub standard curve

On sections of road that have curved alignment, an accident history, and that may pass through an environmentally sensitive landscape, it may be desirable to provide an enhanced warning sign at both approaches to the road section (see Figure 4).



Figure 4: Red background used to emphasise potential hazard

2.1.5 Weather warning systems

A range of conditions related to weather can have an adverse affect on vehicles staying on the

road through their impact on drivers or the road surface. Common conditions include:

- heavy rain
- ice and/or snow
- fog
- water on road
- strong winds.

Weather warning systems may be used on freeway and non-freeway arterial roads where the adverse effects of weather increase the risk of road crashes. Such a system may be as simple as permanent signs, but more complex systems are also possible. For example, an ice warning system can consist of warning lights and signs that are activated by inputs from temperature and humidity sensors. Similarly, a fog warning system could activate advance warning signs and lights in response to inputs from a visibility detection device.

A weather warning system will generally be applicable to a specific location where a particular weather condition, unique to that location, has been identified as a contributor to crash risk. If a system is proposed as a crash countermeasure for a particular site, it is recommended that several years' crash data first be examined to determine that the relevant weather conditions did influence crashes at the site.

2.2 Road design elements

In order to give motorists the best chance of keeping their vehicles on the road, it is necessary to provide a geometric design conducive to safe travel. The principal factor influencing a vehicle's ability to traverse and remain on a particular section of road is the speed of the vehicle. Accordingly, it is necessary to take into account the operating speed of a road section when setting such parameters as curve radii, lane widths, shoulder widths, seal types and drainage.

For full information on the topics in this section the practitioner is referred to the Austroads publications, *Rural Road Design* (2003b) and *Urban Road Design* (2002).

2.2.1 Lane widths

The width of a traffic lane influences the ease with which vehicles can operate in that lane. Higher traffic volumes and higher speeds demand wider lanes to allow more space between passing vehicles, and between vehicles and any roadside objects. Austroads specifies

appropriate lane widths for urban and rural environments in Section 12 of *Urban Road Design* and Section 11 of *Rural Road Design* respectively.

However, the recommended lane widths for the various categories of Tasmanian roads differ from the Austroads requirements and are shown in Table 1. The information in the table has been taken from the draft Tasmanian State Road Hierarchy Target Standards document (October 1999).

Table 1: Recommended lane widths

Road category	1	2	3	4	5
Surface	Sealed	Sealed	Sealed	Sealed	As warranted
Traffic volume (AADT)	Recommended lane widths				
0-1000	N/A	3.0m	3.0m	2.75m	As warranted
1000-2500	N/A	3.0m	3.0m	2.75m	As warranted
2500-5000	3.5m	3.5m	3.0m	3.0m	As warranted
5000 plus	3.5m	3.5m	3.25m	3.0m	As warranted

2.2.2 Shoulder widths (sealed/unsealed)

Apart from its function as a lateral support for the road pavement, a road shoulder is provided as additional road width for a number of traffic-related reasons. The most important of its traffic functions in relation to road management is the provision of a degree of separation between moving traffic and roadside objects. This extra road space, while not intended for regular travel, allows drivers more room to bring their vehicles back under control after inadvertently leaving the traffic lane.

To reduce the incidence and severity of run-off-road crashes it may be desirable to ensure that shoulders are sealed. This will assist errant vehicles to recover should they leave the carriageway. A decision to seal shoulders will depend on the road category, traffic volume and the accident record of the section of road.

The actual width of shoulder sealing will depend on traffic speed, volume and composition, environmental conditions and the nature of the roadside area. Ideally the sealed shoulder width should be between 1.5 and 2.4m as this range was found to be the safest in a recent Austroads investigation carried out by ARRB TR. Section 11.5 of Austroads' *Rural Road Design* (2003b) provides further advice on sealed and unsealed shoulder widths. The information therein is applicable to both rural and urban locations, although shoulders are not usually required in urban settings except for drainage or the storage of broken down vehicles.

However, the draft Tasmanian State Road Hierarchy Target Standards document (October 1999) states specific sealed and unsealed shoulder widths applicable to the various categories of Tasmanian roads, as shown in Table 2.

Table 2: Recommended shoulder widths

Road category	1	2	3	4	5
Surface	Sealed	Sealed	Sealed	Sealed	As warranted
Traffic volume (AADT)	Recommended lane widths				
0-1000	N/A	0.6m sealed	0.3m sealed	0.6m unsealed	As warranted
1000-2500	N/A	1.0m sealed	0.6m sealed	0.3m sealed	As warranted
2500-5000	2.0m sealed	1.5m sealed	1.0m sealed	0.6m sealed	As warranted
5000 plus	2.0m sealed	2.0m sealed	1.0m sealed	1.0m sealed	As warranted

Section 11.5 of *Rural Road Design* provides further advice on sealed and unsealed shoulder widths. The information therein is applicable to both rural and urban locations, although shoulders are not usually required in urban settings except for drainage or the storage of broken down vehicles.

2.2.3 Horizontal curvature and localised curve widening

The careful design of horizontal curves is one of the primary considerations in designing to minimise the danger of roadside hazards. In order for a vehicle to travel around a bend at a certain speed, the horizontal friction between the vehicle and the road pavement must be sufficient to counteract the inertial force that would maintain the vehicle's initial direction. Constructing a bend with as large a radius as the landscape allows is therefore the first step in providing a driveable path. However, it is desirable to have a consistent alignment standard over a section and well designed transitions from generous to tighter alignments.

For the construction of a new road or realignment of an existing road, Chapter 9 of *Rural Road Design* provides guidance on the entire process of designing a road's horizontal alignment.

Widening of the road pavement may be required at curves in the road, dependent on curve radius, lane width and vehicle sizes. One reason for this localised widening is that a vehicle (particularly a

truck or bus) travelling around a curve will occupy more of the lane width than the same vehicle travelling on a straight. This increased width occupied by vehicles also reduces the clearance between vehicles travelling in opposing directions. Extra lane width at curves maintains an acceptable clearance.

The second reason for localised widening on curves is that vehicles typically do not maintain the same lateral position in a curve that they would on a straight. This is due to the requirement that a driver steer through the curve. Some deviation from a perfect path must be expected.

Section 9.10 of *Rural Road Design* discusses localised widening on curves and provides recommended lane widths.

2.2.4 Vertical alignment

Vertical alignment is an important consideration in road design. Flat or almost flat grades should generally be provided where possible. Steep grades become prohibitive or even non-negotiable for heavy vehicles. Flat grades allow all vehicles sharing a road to travel at the same speed. Steep grades, on the other hand, cause different vehicles to travel at different speeds, which creates a higher risk of rear end crashes. Differences in vehicle speeds also contribute to queuing, which may be frustrating to drivers within the queue. Where vertical curves occur in conjunction with horizontal curves extra care in design needs to be taken.

The definition of a 'flat' grade varies according to a road's operating speed. For a speed environment of 100 km/h, a slope of up to five per cent can be considered flat. At lower speeds, steeper grades can be considered flat. The grades listed in Table 3 are taken from Austroads' *Rural Road Design* (2003b) and are suggested maximum grades for various terrain and speed environments. The practitioner must always beware of vertical grades or changes in grade that may impede sight distance. Refer to Section 2.2.6 for further information on sight distance.

Table 3: Maximum grades (%) by speed and terrain

Operating speed (km/h)	Terrain		
	Flat	Rolling	Mountainous
60	6-8	7-9	9-10
80	4-6	5-7	7-9
100	3-5	4-6	6-8
120	3-5	4-6	-
130	3-5	4-6	-

Vertical grades of zero may be provided, although consideration needs to be given to type of drainage provided. Adequate drainage must be provided to prevent water pooling on the road surface during normal levels of rain. Longitudinal drains need to have adequate fall, generally accepted as 0.5 per cent grade.

Chapter 10 of Austroads' *Rural Road Design* (2003b) provides guidance on the design of aspects of vertical alignment issues including grades and vertical curves.

It is recommended that where it is necessary to have a length of steep grade, the length of the section be minimised. Vertical grades of zero to three per cent are considered to have little effect on the operation of all vehicles, while grades in excess of six per cent can have a significant effect on heavy vehicles for travel both uphill and downhill. Safety considerations need also to be addressed in relation to long downhill grades with

regard to the risk of a crash due to brake failure. Where it is necessary to have long steep grades, consideration for the provision of safety features such as passing bays and descending lanes to allow light vehicles to safely overtake slower moving heavy vehicles, or the installation of safety ramps and arrester beds to safely bring a runaway vehicle to rest should be considered. Provision of such features may be particularly relevant to roads with a reasonably high proportion of heavy vehicles. Chapter 13 of Austroads' *Rural Road Design* (2003b) provides guidance on auxiliary lanes for safety and capacity reasons. Section 13.7 provides guidance on the provision of runaway vehicle facilities.

2.2.5 Road surface

A road surface needs to be constructed and maintained to a sufficient standard to ensure adequate skid resistance. The skid resistance of a particular surface is a result of the interaction of surface texture and the presence of moisture. For example, a situation where a pavement can hold water instead of draining properly can contribute to vehicles aquaplaning.

To be sure of the condition of an existing pavement it is necessary to conduct skid resistance measurements as well as an assessment of the level of rutting and the occurrence of potholes. Measurement of skid resistance and rutting can be undertaken using a number of methods, some of which are highly automated and efficient. The decision to act on the results of such measurements is left to the experienced practitioner, however a guide to the use of skid resistance values can be found in the Austroads publication *Guide to the selection of road surfacings* (Austroads 2003a).

Roads with a comparatively high volume of heavy vehicle traffic (usually major link routes) may require a higher standard of construction and maintenance than roads that predominantly carry light vehicles such as cars and vans.

2.2.6 Sight distance

It is important that adequate sight distance is provided whenever possible to allow drivers and

other road users to safely negotiate the road. Sight distance can be affected by the road geometry (horizontal and vertical alignment), terrain (particularly on the inside of horizontal curves) and roadside objects (such as trees and signs). Section 8 of *Rural Road Design* discusses sight distance in general, while section 9.11 looks more specifically at sight distance on horizontal curves. Section 3.4 of AS1742.2-1994 discusses signage of substandard curves.

A number of sight distance types can be calculated, dependant on the driving environment. These include:

- Stopping sight distance – the minimum sight distance that should be available for a driver. As defined by Austroads' *Rural Road Design* (2003b), this is the distance that it takes for a "normally alert driver, travelling at the design speed on a wet pavement, to perceive, react and brake to a stop before reaching a hazard on the road ahead". Section 8.3 of Austroads' *Rural Road Design* (2003b) looks at stopping sight distance, outlines the method for calculation and provides tables for the minimum car and truck stopping sight distances required for various operating speeds and grades.
- Overtaking sight distance – the distance required by a driver "to safely overtake a slower moving vehicle without interfering with the speed of an oncoming vehicle". This is only considered for two-lane two-way roads, where an overtaking manoeuvre requires a driver to travel on the wrong side of the carriageway. Section 8.4 of Austroads' *Rural Road Design* (2003b) focuses on overtaking sight distance.
- Manoeuvre sight distance – is the distance required for a driver of a vehicle to react and manoeuvre around an obstacle. Manoeuvre sight distance is less than stopping sight distance and is the absolute minimum sight distance that may be provided. Section 8.5 of Austroads' *Rural Road Design* (2003b) discusses the circumstances in which the use

of manoeuvre sight distance instead of stopping sight distance may be acceptable.

- Headlight sight distance – the distance for which a small unilluminated object is visible in a vehicle's headlights. It is generally limited to 120 to 150m, which corresponds to a safe stopping sight distance for 80 to 90 km/h. Section 8.6 of Austroads' *Rural Road Design* (2003b) looks at headlight sight distance.
- Horizontal curve perception distance – where a horizontal curve exists, drivers need to be aware of the curvature of the road ahead, react and slow down (if necessary) to safely navigate the curve. It needs to be ensured that a driver can see a sufficient length of curve in order to judge its curvature and safely navigate the curve. It is recommended that a curve should not commence just over the crest of a hill. However, where this situation is unavoidable, it needs to be ensured that drivers are aware of the curved road alignment ahead.

Roadside features (such as embankments and vegetation) that limit sight distance should be removed or modified to ensure sufficient stopping sight distance on curves. If this is not practical, speeds should be reduced through such sections to compensate (for example, with warning signs). It is important that roadsides are maintained to ensure that sight distance requirements are sustained, for example by regularly pruning trees and cutting grass.

On substandard curves it may be appropriate to cut benches in high batters (see Figure 5) in order to improve sight distance. Sections 11.7 and 9.11.1 of Austroads' *Rural Road Design* (2003b) discusses design and use of batters and benching.

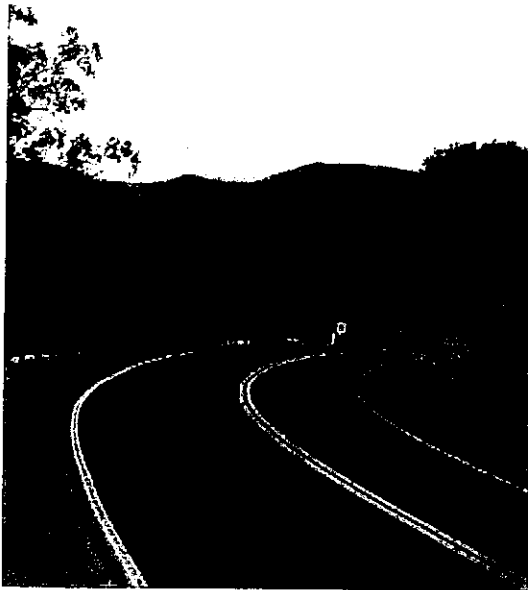


Figure 5: Benching on inside of horizontal curve

2.2.7 Drainage

Drainage of the road surface and surrounding areas is an important consideration for road design. A number of different aspects need be considered with regard to drainage. These include:

- drainage of the road pavement – by providing adequate grade and crossfall so that the pavement is able to drain and pooling of water is avoided, which allows maintenance of skid resistance
- appropriate infrastructure to collect and transfer the water from the pavement, which may include kerb and channel or table drains
- a road reservation that can accommodate water run-off from adjacent land uses.

If constructed along a flow path, a road may need to be designed to be able to handle the run-off from adjacent land for a flood event.

Drainage design at the road design stage requires consideration of flood estimation. Chapter 16 of the Austroads' *Rural Road Design* (2003b) looks into drainage and lists a number of rural flood estimation methods for gauged and ungauged catchments. Similar information is available for urban areas in Chapter 15 of Austroads' *Urban Road Design* (2002).

3 Dealing with errant vehicles

The ideal roadside environment would be completely free of any obstructions to the safe passage of errant vehicles. Such a roadside would prevent injuries in run-off-road crashes by providing drivers with enough space to regain control of their vehicles and stop safely without colliding with any objects or the vehicle rolling over. However, it is usually not possible to construct a road environment completely free of hazards. There is usually a requirement for signage, utility poles and other roadside furniture, and often the topography of the landscape necessitates the provision of cut or fill embankments.

3.1 Clear zones

A clear zone is an area adjacent to the traffic lane that should be kept free from features that would be potentially hazardous to errant vehicles. The clear zone is a compromise between the recovery area for every errant vehicle, the cost of providing that area and the probability of an errant vehicle encountering a hazard. Where economically viable, the clear zone should be kept free of non-frangible hazards and all features that would 'snag' a vehicle or cause it to roll. Alternatively, hazards within the clear zone should be treated to make them safe or be shielded by a safety barrier. Clear zones are measured from the edge of the traffic lane.

Clear zones are intended as a guide to by which practitioners can assess sites, not a prescriptive value. Practitioners may provide a greater or lesser width depending on the risk factors applying to a particular site.

The Austroads method of calculating clear zone widths takes into account traffic volume, 85th percentile speed, curve radius and roadside slope. The use of this method is presented in Section 17.3 of Austroads' *Rural Road Design* (2003b) and the charts that make up the method are reproduced here as Figures 6, 7 and 8. Note that Figure 7 provides a multiplying factor for the output of Figure 8.

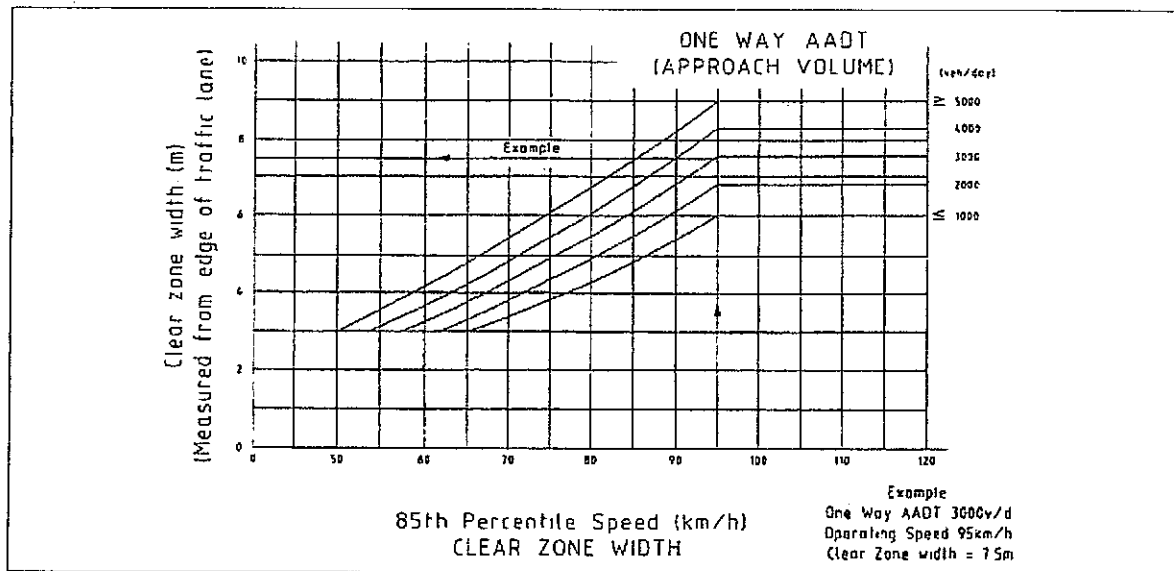


Figure 6: Clear zone width chart (Austroads 2003b)

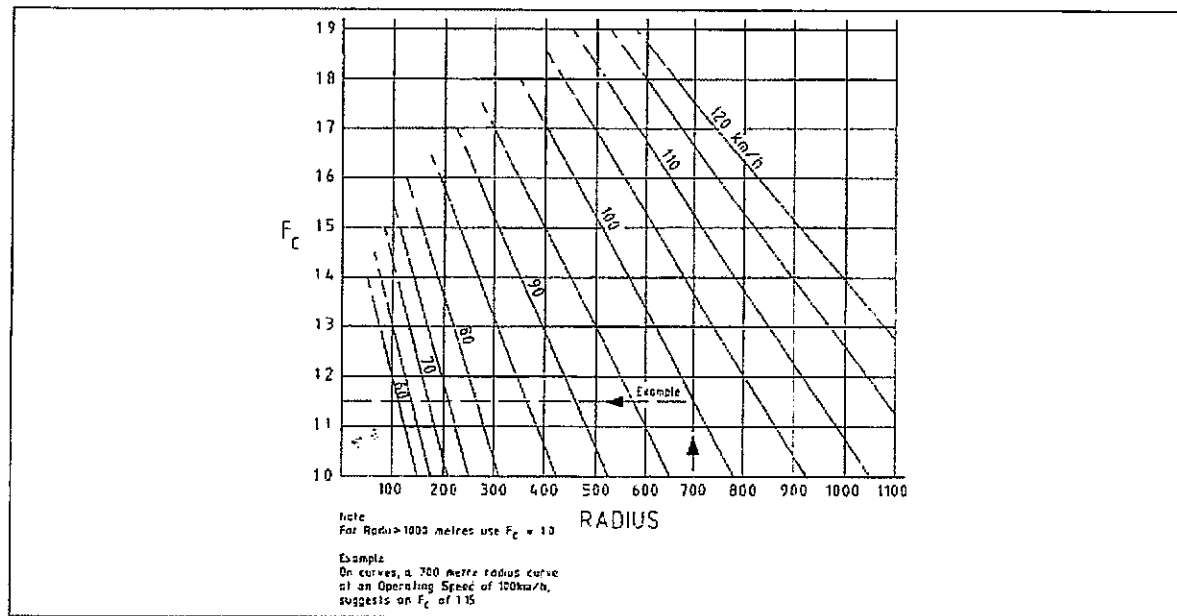


Figure 7: Curve adjustment factors for clear zones (Austroads 2003b)

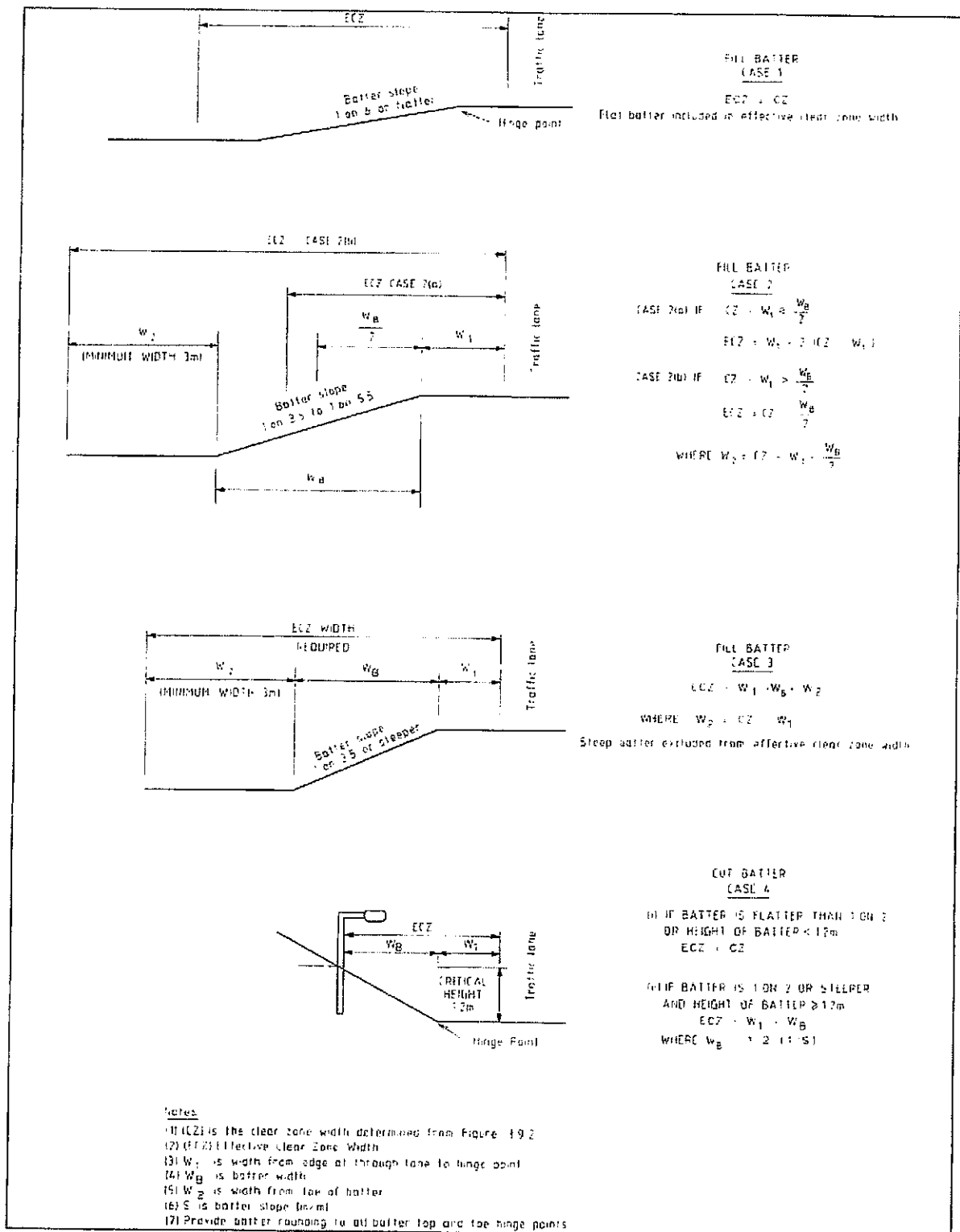


Figure 8: Clear zone widths for batters (Austroads 2003b)

3.2 Types of hazards and their treatments

The following section identifies hazards that may be found in the roadside environment and possible treatments to reduce the risk of these hazards to drivers. For the purpose of hazard identification, the types of hazard that may be encountered in roadsides can be divided into five broad categories:

- embankments
- rigid objects – trees, utility poles, culvert end-walls etc
- medians (cross median crashes)
- open drains
- bodies of water.

Notwithstanding that there are physical, environmental and economic constraints, the preferred treatments (in order of preference) of roadside hazards are:

- removal
- relocation to reduce the chance of them being hit
- redesign so that they can be safely traversed
- redesign to be frangible or break away, or to otherwise reduce severity
- shielding with a traffic barrier or impact attenuator
- delineation of the hazard.

Each option for hazard reduction is to be ranked according to benefit cost analysis techniques and engineering judgement.

Because of the number of variables and complexity of the analysis, computer software such as the following may be used to perform the quantitative analysis associated with the evaluation process:

- Roadside Incident Severity Calculator (RISC) developed by Main Roads Queensland.

- Road Safety Risk Manager (RSRM), a prioritisation program developed by ARRB Transport Research in association with Austroads.
- USA Roadside Safety Analysis Program (RSAP), refer TRB web site (<http://www4.trb.org/trb/crp.nsf/All+Projects/NCHRP+22-09>).

3.2.1 Embankments

Batter slopes

Section 11.7 of Austroads' *Rural Road Design* (2003b) provides guidance on use and design of batters. It is important that batters are constructed to allow errant vehicles to negotiate the slope safely in the event of a run off road crash. If there is a risk that a batter slope is severe enough to cause an errant vehicle to overturn during a crash, installation of a safety barrier should be considered. Design slopes for both cut and fill batters are listed for arterial and local roads in Table 11.7 of *Rural Road Design*.

One aspect of batter design not covered by the Austroads document is the concept of recoverable, non-recoverable and critical fill batter slopes. These terms refer to the likelihood of a vehicle overturning on various slopes. Practitioners should be aware of these definitions.

After running off the road onto a recoverable batter slope, a driver will usually be able to regain control of the car and return to the road or stop safely. On a non-recoverable slope, the driver is unlikely to be able to return to the road but will be able to stop safely at the bottom of the slope. A critical slope will probably cause the vehicle to overturn.

The AASHTO *Roadside Design Guide* (AASHTO 2002) defines recoverable slopes as flatter than 1 on 4 (ie. a fall of one metre for every four metres of width), non-recoverable as between 1 on 4 and 1 on 3, and critical as steeper than 1 on 3.

Cuttings and rock faces

Cuttings and rock faces are generally expensive to construct. Economic and environmental constraints often result in cuttings being as narrow as possible and prevent the provision of a cutting wide enough to allow for clear zones. Therefore, cuttings and rock faces should be cut to provide a smooth face to act as a rigid barrier, allowing errant vehicles to slide along and stop gradually. Uneven surfaces, may present a hazard to vehicles that happen to run off the road. If a smooth face and approach surface cannot be provided, it may be appropriate to install a barrier to prevent vehicles colliding with an uneven rock surface.

Deep, unprotected drains should not be provided at the base of the cut batter. Effective redirection of vehicles requires a flat even surface approaching the embankment.

3.2.2 Rigid objects

Poles

Poles are a common road furniture item used to support signs (regulatory, warning, guidance, informative), road lighting and various devices. In line with the preferred treatment for roadside hazards (removal), the practitioner's aim should be to minimise the number of poles in the clear zone.

The hazard presented by a roadside pole is related to both its location and type of construction. Both of these contribute to the hazard the pole may pose and the consequences of an errant vehicle hitting the pole.

Where possible, poles should be located such that an errant vehicle is unlikely to hit them. Minimum lateral set back distances for signs and for road lighting poles are specified in Australian Standards AS1742.2 and AS/NZS1158.1.3-1997 respectively.

Sign posts should be designed to be frangible in the event of collision with an errant vehicle, i.e. posts that are designed to fracture, break away, give way or bend such that the damage to a

colliding vehicle and risk of injury to vehicle occupants upon impact is minimised. Small signs are usually supported by posts that deform in a way that causes minimum damage to cars, whereas larger posts and supports (for larger signs) may be provided with mechanisms that are designed to yield in a controlled manner upon impact.

Sign poles

Appendix C of AS1742.2-1994 discusses aspects of longitudinal and lateral placement and mounting height for signs, orientation, post type and selection. Signs should be erected such that sight distance is not compromised. Longitudinally, signs should be located to provide enough warning for a driver to be able to make a decision and respond as necessary. It is also important that signs are spaced far enough apart longitudinally that drivers are able to process the information before encountering another sign.

In a rural setting (unkerbed roads), signs should generally be placed between 2m and 5m from the edge of the outside lane, and at least 600 mm from the road shoulder. Signs should be mounted at a height at least 1.5m above the carriageway level.

In an urban setting (kerbed roads), signs should be located at least 300 mm behind the face of barrier kerbing and 500 mm from mountable or semi-mountable kerbing. Signs should generally be mounted at least 2m above the top of kerb or 2.5m above a footway, to allow for pedestrians and parked vehicles. In some circumstances, signs may be mounted lower than 2m.

Overhead mounted signs are often employed for multi-lane carriageways and freeways. They should generally be mounted a minimum of 5.3m above a carriageway.

Light poles

Appendix B of AS/NZS1158.1.3-1997 discusses the use and placement of rigid and frangible road lighting poles.

Rigid poles do not deform to a great extent, but are designed such that they remain upright after an impact. Alternatively, frangible poles are designed to deform upon vehicle impact. Types of frangible poles include:

- slip base poles – break away at the base upon impact, allowing the vehicle to pass beneath the pole and causing aiming to minimise or avoid injury to vehicle occupants (see Figure 9)
- deformable poles – collapse over the colliding vehicle and are designed to bring the vehicle to a controlled stop at the base of the pole (see Figure 10). Deformable poles are designed to remain in the ground after being hit.

The decision to use slip base poles will depend on the space available and the resultant likelihood that a falling pole would cause injury to other users of the road or roadside area. For example, a slip base pole will usually be inappropriate where pedestrian or cyclist traffic is common because a falling pole would pose an unacceptable risk to those road users.

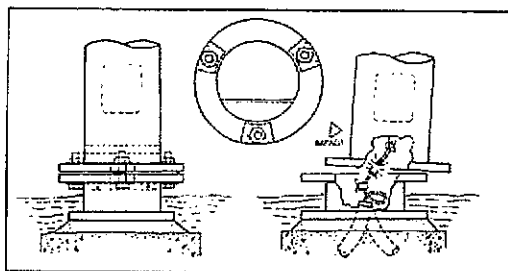


Figure 9: Slip-base pole (Austroads 1988)

Aspects involved in the selection of pole type and set back from carriageway include:

- surrounding land use and pedestrian activity
- speed limit
- whether road is kerbed or unkerbed
- location – mid-block or intersection
- road alignment

- whether pole is to be located behind safety fence or on front of/ behind an obstruction.

Refer to section B6 of Appendix B of AS/NZS1158.1.3-1997 for detailed information.

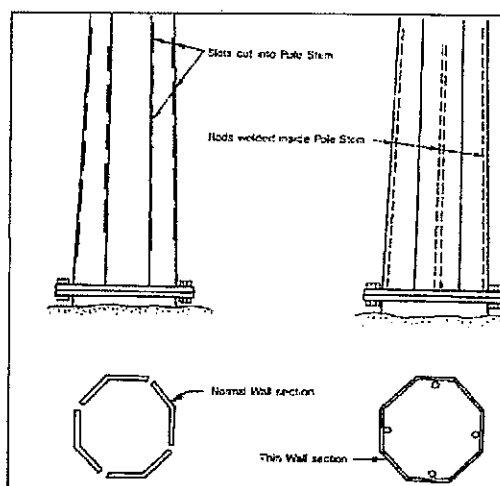


Figure 10: Deformable pole (Austroads 1988)

Other – service poles

Service poles, such as electricity poles, are generally rigid as the consequences of one being toppled over can be very serious. The ideal treatment of service poles is to remove them and relocate services underground. Where this is not possible, service poles should be located where it is unlikely an errant vehicle may hit them. This may involve locating them at the property line (urban and rural) or in an easement (rural).

Trees

Trees greater than 100 mm in diameter located within the clear zone pose a potential hazard to motorists.

New trees should be located outside of the clear zone so that they do not pose a serious roadside hazard risk. Where existing trees are within a clear zone, and are deemed to pose a risk, the first option is to remove the tree. Where this is not feasible it may be appropriate to install safety barrier. Provision of a safety barrier will depend on a number of factors relating to site conditions, accident history, economics and the environment. However, such action should only

be taken where it is determined that collision with the barrier is less severe than collision with the existing hazard (i.e. trees).

It is also important that trees are pruned regularly enough to ensure that any growth does not restrict sight distance.

Minor roadside obstacles (fire hydrants, mail boxes and other roadside hazards)

Minor roadside obstacles should not pose a serious risk to an errant vehicle that may strike the object. Objects containing horizontal rails capable of spearing vehicles (such as post-and-rail fences) can be particularly hazardous. Such objects should be located outside the clear zone or such that impact with the object should not result in a serious crash.

Traffic signals

As for other roadside furniture, traffic lights can pose a hazard for any errant vehicles. They are often necessarily located close to the carriageway of intersections, which could lead to a higher risk of impact, although some measures can be taken to minimise this risk. Such measures include not locating a light pedestal on the outside of a curve, setting poles as far back from the carriageway edge as practicable, minimising the number of poles and joint use of poles. Provision of high skid resistance at intersections can also reduce the risk of a vehicle losing control at an intersection and skidding into traffic pedestals or other roadside hazards.

Culverts

The ends of culverts that cross under the road or are located parallel to the road constitute hazards for motorists. They should be relocated, treated or shielded if within the clear zone.

Parallel to road (driveable treatment)

Driveable treatments need to be installed wherever a culvert exists parallel to the road and within the clear zone (see Figure 11).

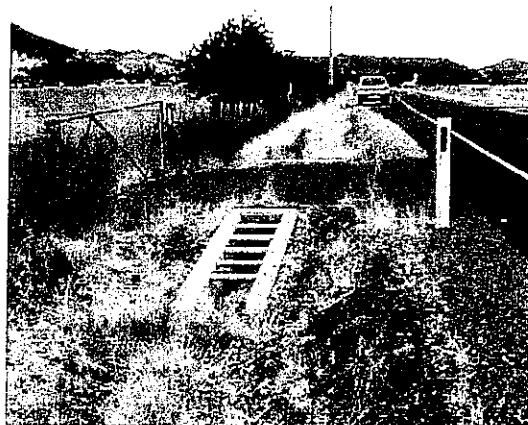


Figure 11: Driveable culvert situated parallel to road

Perpendicular to road (headwall treatment)

Culverts that run perpendicular to the road (i.e. run under the road) need to be:

- driveable if the fill batter is of a low enough slope
- protected with an appropriate barrier if the slope is not driveable.

Bridge end posts

Bridge ends need to be designed to prevent vehicles from running into end support posts, being speared by any horizontal bridge members or simply crashing through any approach barrier and being exposed to a hazard (eg roll-over, water course).

Stiffening needs to be provided on the transition from the semi-rigid approach barrier to the rigid bridge structure.

The piers of bridges over roads (at overpasses) should desirably be protected by a crash cushion or safety barrier.

3.2.3 Open drains

A drainage channel is defined as an open drain usually parallel to the highway and within the limits of the highway right of way (AASHTO, 2002). Open drains are present on the majority of rural roadsides and may also exist on urban

freeways. Their primary function is to collect and carry the surface water away from the roadway. Open drains are designed to accommodate run-off from heavy rain storms with minimal highway flooding or damage. Deep drains constructed close to the road may be the most efficient way of removing water but, unless they are of a suitable shape, they are a hazard for errant vehicles that leave the road.

Typical drains can be classified by whether they are designed with abrupt or gradual slope changes. Abrupt slope change designs include vee drains, rounded drains with bottom widths less than 2.4m, and trapezoidal drains with bottom widths less than 1.2 m.

Vehicles leaving the roadway and encroaching into a drain face three hazard areas:

- **Drain front slope.** If the front slope is 1:4 or steeper, the majority of vehicles entering the ditch will be unable to stop and can be expected to reach the bottom.
- **Drain bottom.** Abrupt slope changes can result in errant vehicles colliding with the bottom of the ditch.
- **Drain back slope.** Vehicles travelling through the ditch bottom or becoming airborne from the front slope can collide with the back slope.

The AASHTO Roadside Design Guide (AASHTO 2002) contains figures describing the preferred design for abrupt and gradual change slopes. These figures are presented in this Document at Figure 12 and Figure 13 respectively. Drain cross sections that fall within the shaded region of each of the figures are considered as traversable. These preferable drain designs are not considered hazardous and need not be constructed at or beyond the clear zone distance for a specific roadway.

Drain sections that fall outside the shaded area of the figures are considered non-traversable. As a general rule, these drains should either be:

- reshaped
- converted to a closed system (culvert or pipe)
- located beyond the clear zone
- where appropriate, shielded with a traffic barrier.

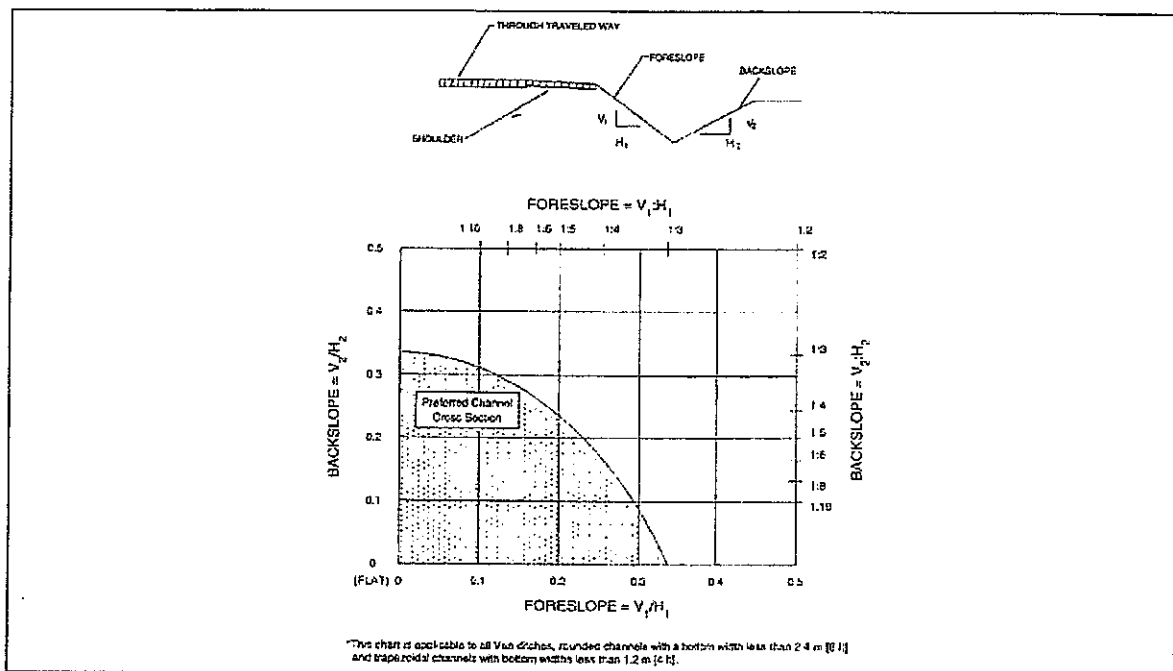


Figure 12: Preferred cross sections for channels with abrupt slope changes (from AASHTO (2002))

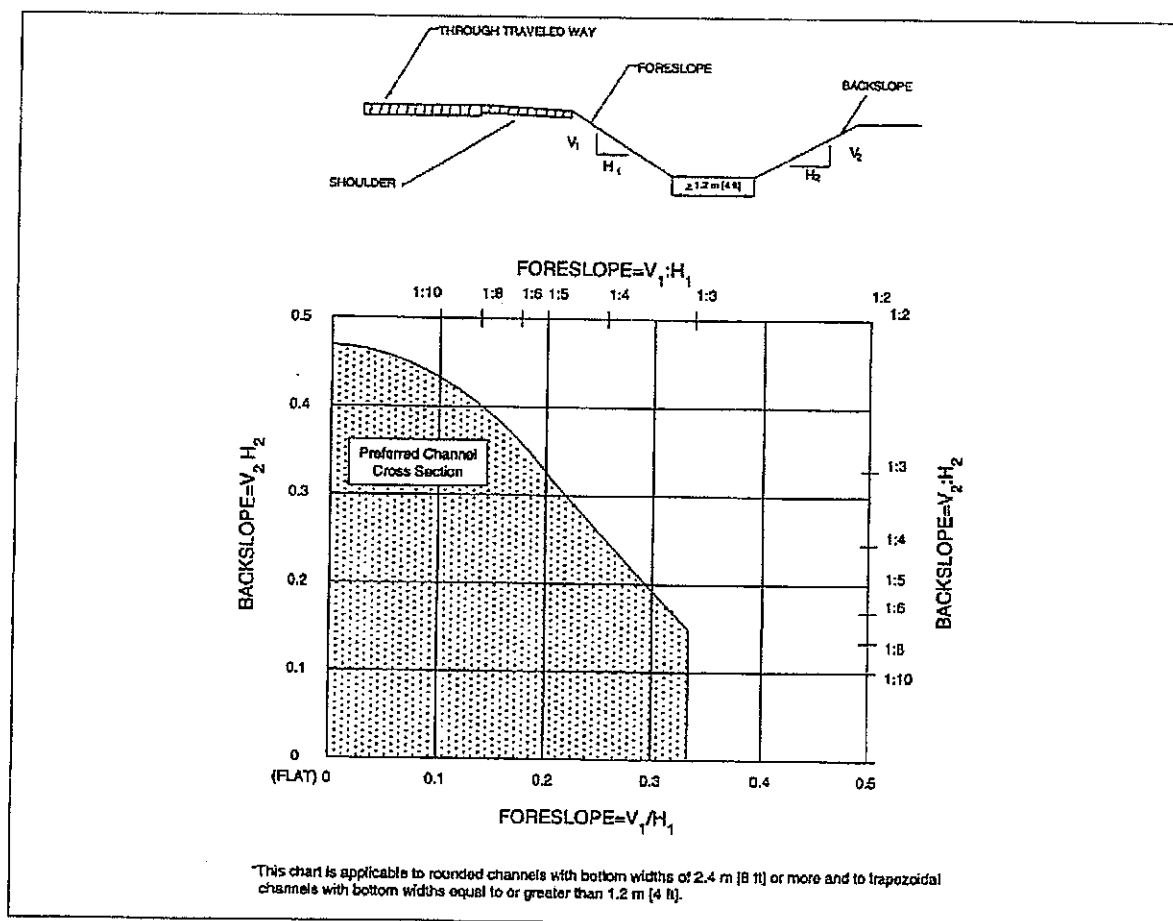


Figure 13: Preferred cross sections for channels with gradual slope changes (from AASHTO (2002))

If the drain bottom and slopes are free of any fixed objects, then non-preferred drain sections may be acceptable for roads or projects where a better treatment is impracticable or uneconomical because of factors such as:

- restrictive right-of-way
- rugged terrain
- resurfacing, restoration or rehabilitation projects where these works result in an unavoidable change to the shape of a drain and it is not feasible to provide a compliant shape
- low volume, low speed roadways.

Drains of both the abrupt and gradual slope designs can funnel a vehicle along the drain bottom. This increases the probability of impact with any fixed objects present on the bottom or side slopes of the drain. Breakaway hardware

may not operate correctly if the vehicle is airborne or sliding sideways when contact is made. For these reasons, non-yielding fixed objects should not be located on the side slopes or bottom of drains.

Back slopes typically occur when roadways are constructed by cutting the existing terrain away to develop the roadbed. If the slope between the roadway and the base of the back slope is 1:3 or flatter, and the back slope is obstacle free, then the back slope may not be a significant hazard regardless of its distance from the roadway. Back slopes that will not provide a relatively smooth redirection or that can cause vehicle snagging should begin outside the clear zone or be shielded. This usually includes rough sided rock cuts when the rough face can cause excessive vehicle snagging.

3.2.4 Bodies of water

Bodies of water should be evaluated with respect to the degree of potential hazard they pose. This will be a combination of the amount of water and its accessibility. The depth may be ranked according to whether

- a vehicle can completely submerge, resulting in the drowning of uninjured non-swimmers, disabled or elderly persons, or infants
- water could fill an upright car to a point where an unconscious or injured driver or passenger would drown (typically / assumed to be a depth of 0.6 m)
- an upside down car would be in water deep enough that an unconscious person would drown (a depth of 0.3 m).

Fast moving bodies of water should be considered to be more hazardous than those that are still. In general, practitioners should carefully consider the risk associated with bodies of water over 0.6 m deep, or water courses with a normal base flow depth greater than 0.6 m, as these could cause a stunned, trapped, or injured occupant to drown.

Other factors to consider include the:

- slope of the vehicle path to the water
- total distance available in which to stop
- persistent or intermittent presence (flooding potential) of the water hazard
- presence of intervening obstructions that would reduce the likelihood of an errant vehicle reaching the water.

The practitioner should visualise the paths that errant vehicles are likely to take in reaching the water. If the water hazard is substantial and the likelihood of errant vehicles reaching that water is high enough, the practitioner should consider providing shielding to prevent access to that course.

3.3 Safety barriers

In instances where a roadside hazard cannot be made safe, removed or relocated, it may be necessary to provide physical protection from the hazard. Safety barriers are available for a variety of applications and this section provides advice on selecting, installing and maintaining safety barriers.

The Australian Standard document "AS/NZS 3845:1999 Road Safety Barrier Systems" discusses various methods of roadside hazard protection and provides direction on the correct use of the different systems. The Standard has been the basis for a number of guidelines written by individual road authorities for use within their jurisdiction.

It should also be noted that the Austroads publication *Safety Barriers* (1987) is currently being reviewed and updated.

3.3.1 Decision to install a safety barrier

Safety barriers are a form of roadside hazard. When considering whether to install a safety barrier, it is important to remember that the barrier will present some danger to the occupants of errant vehicles, and especially to unprotected road users such as motorcyclists. A barrier should only be installed if collision with it will present less of an injury risk to vehicle users and occupants than would result from collision with the roadside hazard that is to be shielded by the barrier.

It is important to consider specifically the danger posed to motorcyclists by both the hazard and the intended safety barrier. As essentially unprotected road users, motorcyclists are particularly vulnerable to unforgiving roadside environments; any obstacle in the path of an errant motorcyclist has the potential to cause severe injury. If it is decided that a safety barrier is necessary at a site, attention should be paid to the design of the barrier to ensure that it poses as little risk as possible to colliding motorcyclists.

3.3.2 Barrier types

The following sections describe a number of roadside safety barriers and end-treatments. This list does not contain all available types of barrier, and the practitioner should be aware that manufacturers continually develop new or improved barrier designs. Accordingly, the information presented here refers to testing procedures, the results of which can be used to determine the suitability of proposed barriers. No barrier should be installed unless it has been shown to meet the applicable standards and can therefore be expected to perform satisfactorily.

Barrier types include rigid barriers, semi-rigid barriers and flexible barriers. Semi-rigid and flexible barriers are preferred as they generally cause less damage to vehicles during a crash, while a rigid barrier is suitable where space is limited and it is placed relatively close to the traffic lane (eg. narrow median).

Where a barrier is essential, the practitioner should bear in mind that barrier posts are the main cause of injury to motorcyclists. Other barrier attributes that are considered to be dangerous to motorcyclists (ATSB 2000) include upper and lower edges (particularly if jagged edges exist), protruding reflectors, low barrier mounting height (as motorcyclists can be thrown over the barrier) and rigid barriers.

Guards have been designed to reduce the severity of motorcycle collisions with barriers. These are available in a range of designs for various types of barrier. They should be considered for use at sites where motorcyclists are subject to high risk of collision with barriers.

Wire rope safety fence

Flexible barriers cause the least damage to vehicles, and pose the smallest risk of injury to vehicle occupants, of all barrier types. Flexible barriers usually consist of cables, held in tension, suspended from closely-spaced posts. The cables may be arranged in a variety of ways, depending on the manufacturer (see cross-section diagrams in Figure 14 and Figure 15).

Such a configuration is commonly known as a wire safety rope barrier. The posts simply support the cables and provide little resistance to a colliding vehicle. When a vehicle strikes a wire rope barrier, the barrier catches the vehicle and brings it to a halt. During a collision a wire rope

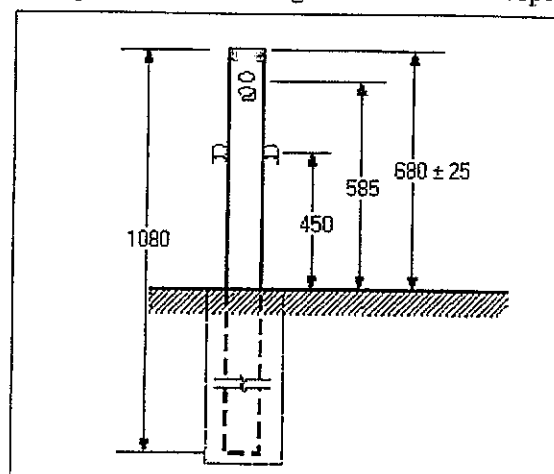


Figure 14: Wire rope safety fence, twisted array

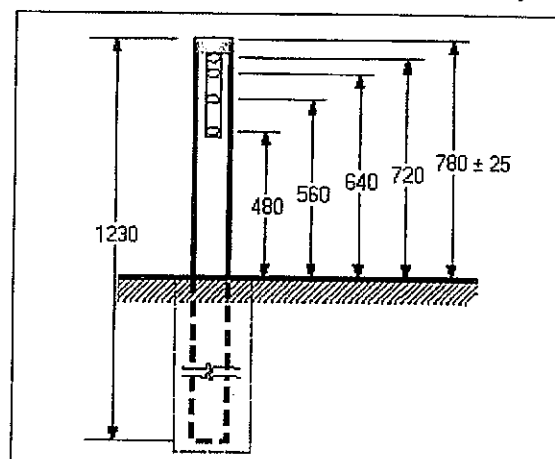


Figure 15: Wire rope safety fence, vertical array

barrier may deflect by more than a metre, meaning that a wire rope installation requires more clear space behind it than is required by a semi-rigid or rigid barrier.

W-beam

One of the most common types of roadside safety barrier on Australian roads is W-beam (Type G4) guard fence. It is a semi-rigid barrier constructed of a steel rail mounted on steel C-channel posts. The profile of the rail resembles

the shape of a 'W' turned on its end (see Figures 14, 15 and 16).

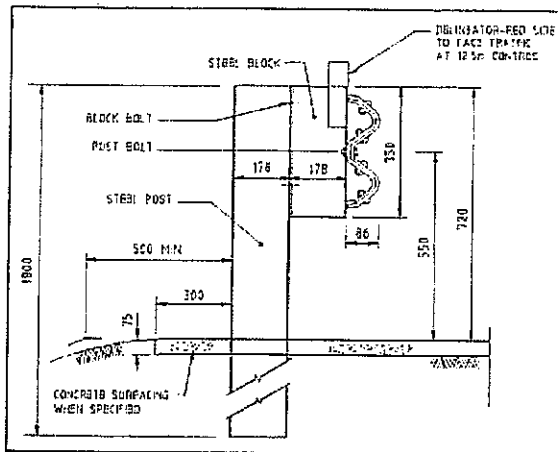


Figure 16: W-beam safety barrier

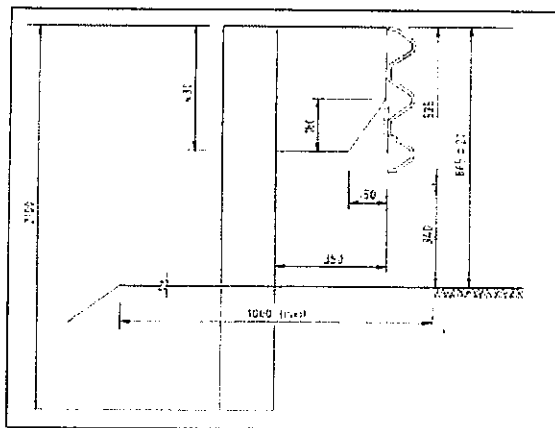


Figure 17: Thrie-beam safety barrier

This type of barrier is designed to deform when struck but to also retain its tensile strength and keep the vehicle from passing through. The deformation of the barrier gradually dissipates the energy of the vehicle impact and aids in redirecting and stopping the vehicle.

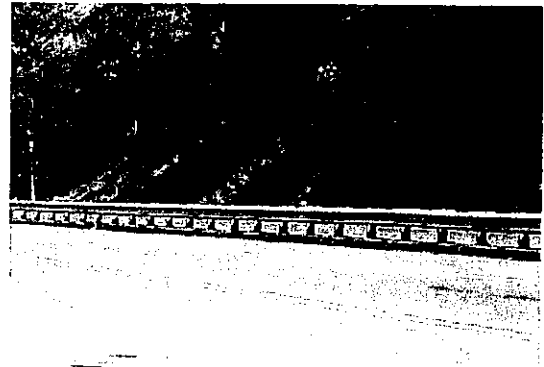


Figure 18: W-beam used as a median barrier

Square hollow section

Another type of semi-rigid barrier is the square hollow section barrier. They comprise continuous square hollow sections and weak support posts designed to break away at point of impact to allow the square hollow section to work in tension and allow the errant vehicle to come to rest gradually (see Figure 19). Section 5.4.1.4 of the AASHTO Roadside Design Guide (2002) discusses the box beam barrier.

This type of barrier is no longer recommended by Austroads for use in Australia and should be replaced with wire rope or W-beam safety barrier at the end of its life.

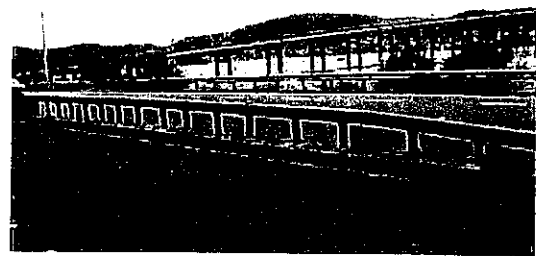


Figure 19: Square hollow section used as a median barrier

Concrete barrier

Concrete barriers belong to the group known as rigid barriers. Rigid barriers are designed to retain their shape and position when struck by a vehicle, thereby requiring no deflection space. Often a rigid barrier is the only appropriate

choice when space is limited, such as the median treatment shown in Figure 21. However, less aggressive barriers should be used where possible

Various types of rigid concrete barrier are shown in Figure 20 below.

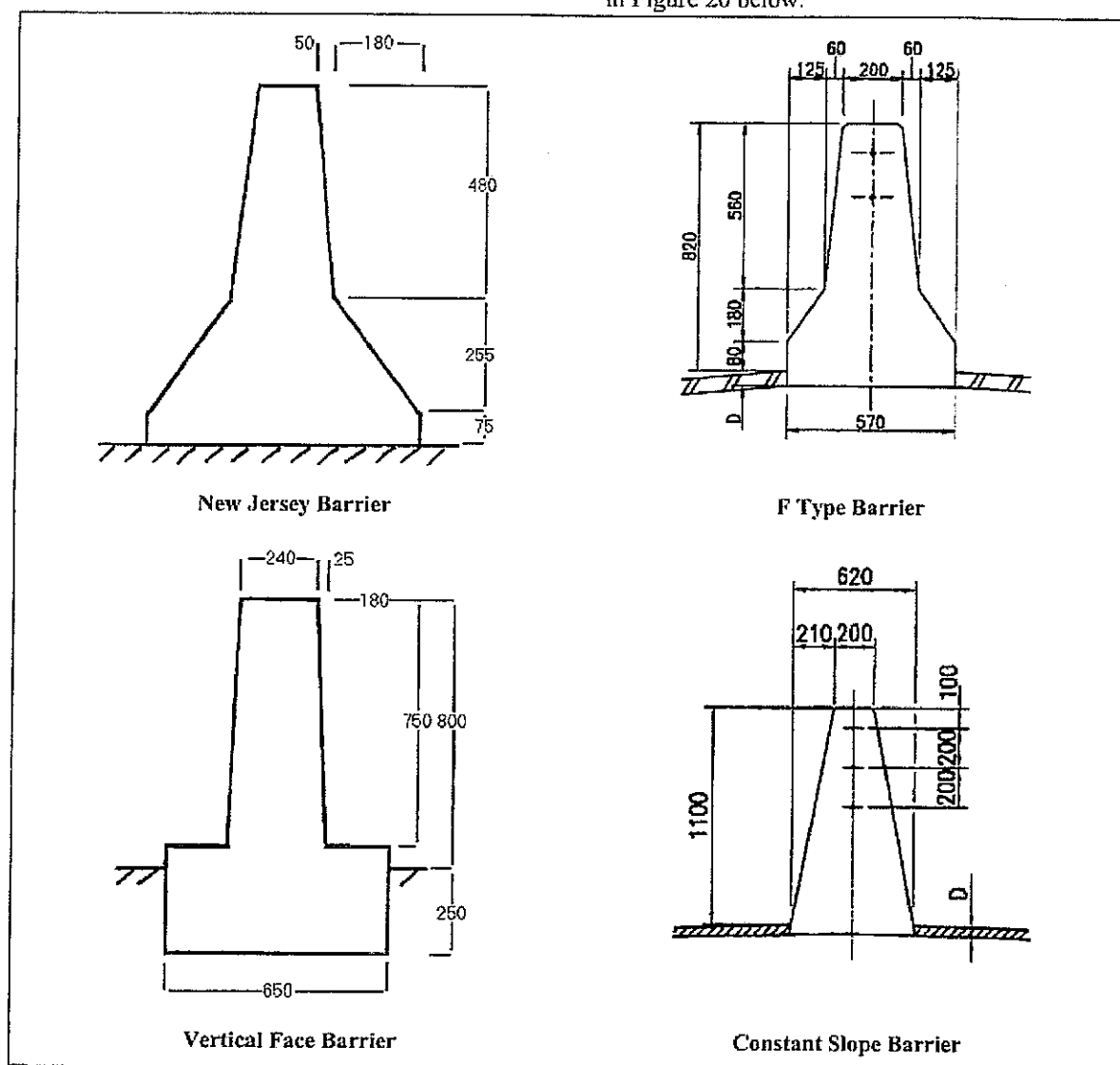


Figure 20: Concrete barrier profiles

The mode of operation of sloping concrete barriers such as New Jersey, F-shape and constant slope barriers is to redirect an errant vehicle and slow it down by forcing it to ride up the side of the barrier.

Concrete barriers and, to a lesser extent, steel beam barriers, can reduce sight distance around bends if not carefully sited. Practitioners should take this into account when specifying barriers on bends and, if possible, take other measures to improve sight distance or warn drivers to take more care of approaching hazards.



Figure 21: Rigid median barrier

Vegetation

An appropriate type of vegetation can slow vehicles down without injuring occupants. It may also be successfully used in conjunction with a manufactured barrier to improve aesthetics. However, vegetation can not be relied upon to act as a reliable continuous barrier, and hence provide protection for motorists. Vegetation can be successful as a headlight screen, particularly on dual carriageways.

Post-and-cable fencing

Post-and-cable fencing is in place along many road sections in Tasmania.

The fencing consists of heavy stranded cable slung between steel I-section posts. Two cables are usually employed, with one cable close to the top of the posts and another cable approximately 250mm below the top cable. The cables are not tensioned.

This type of fencing has not been tested against the criteria in AS3845:1999 and should not be used in any new installations. Any existing installations that require renewal or repair should be removed and replaced with an approved type of safety barrier. W-beam is the suggested replacement for post-and-cable fencing. It is able to be curved to a minimum radius of 3m, making it suitable for the small-radius curves for which post-and-cable fencing has been used in the past.

3.3.3 Layout of safety barriers

An installation of longitudinal safety barrier will usually require a leading terminal, an intermediate section and a trailing terminal. The exact layout of these components will depend on the individual site and barrier type, but the general concept is illustrated in Figure 22.

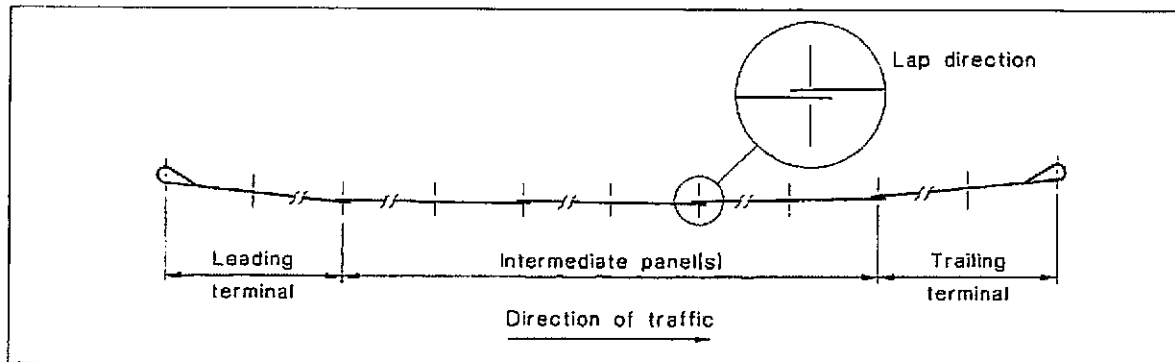


Figure 22: Typical safety barrier layout – plan view (AS3845:1999)

3.3.4 Appropriate lengths

The non-rigid barrier types rely on a degree of tensile strength to enable them to restrain vehicles. They must be of a certain minimum length in order to develop sufficient tension. A barrier that is too short will not be able to deform around a colliding vehicle without breaking off its posts. A recommended minimum length for

any W-beam barrier is 20m plus appropriate end terminals. Practitioners will need to seek advice on minimum lengths directly from barrier manufacturers for specific installations as specifications may vary depending on design.

3.3.5 End treatments

Road safety barrier terminals are covered in section B2.3.11 of AS/NZS 3845:1999. Terminals may be either gating or non gating. *Gating* terminals are designed to allow a vehicle to pass through and come to rest in the clear zone area behind the terminal. Installation of a gating terminal should only be used if a driveable clear zone exists behind the barrier terminal. In other words there should be no hazards behind the gating treatment. If the intended position for a gating terminal is such that a colliding vehicle would pass through the terminal and strike a hazard, the barrier needs to be longer so that the terminal is in front of a more forgiving roadside.

Non-gating terminals are designed to redirect the errant vehicle without allowing it to pass behind the safety barrier. This type of terminal is appropriate if a hazard exists behind the safety barrier.

Terminals for rigid barriers

Unless the approach end of a rigid barrier can be buried in a cut embankment, it will usually be necessary to construct a semi-rigid terminal for the barrier. The junction between the semi-rigid and rigid barriers forms a gradually stiffening surface to guide vehicles onto the rigid barrier after they first make contact with the semi-rigid terminal. Semi-rigid terminals are discussed below.

Where it is necessary to protect road users in head-on impacts with rigid barriers, a crash cushion is the recommended treatment. A crash cushion consists of an arrangement of materials designed to reduce injury in head-on impact with the end of a barrier.

A large range of proprietary crash cushion products are available to suit various site conditions. Many such devices are designed to absorb the impact of a colliding vehicle and then return almost to their full pre-collision position. This design feature enables the unit to function as a crash cushion after a collision. While this feature should not be used as a reason to reduce

maintenance, it does provide a degree of road user protection before repair is undertaken.

Note that it is not acceptable to use a sloped end as a rigid barrier terminal. Such designs have been found to increase the risk of colliding vehicles becoming airborne on impact. Where a ramp end exists it should be either removed and replaced with a more appropriate terminal treatment, or shielded by another terminal.

Terminals for semi-rigid barriers

Semi-rigid barriers such as W-beam can be terminated with a number of different terminal designs. The type used in a particular case will depend on the characteristics of the installation.

The breakaway cable terminal (BCTA) is common around Tasmania, although it has been superseded by the slotted breakaway cable terminal (SBCT), which is now the recommended terminal. The SBCT uses weakened timber posts and a slotted W-beam to cause the terminal to break and swing back behind the barrier when struck by a vehicle. The SBCT shown in Figure 23 has a clear, driveable batter behind it.



Figure 23: Slotted breakaway cable terminal (SBCT)

Various other types of terminal are available from a number of commercial manufacturers. The practitioner should consult barrier manufacturers for information regarding appropriate applications. Any terminal used must have met AASHTO's crash test requirements.

Terminals for flexible barriers

Flexible barriers do not require any special terminal treatments. The end of each length of barrier terminates at ground level and does not pose any more injury risk than the rest of the barrier.

3.3.6 Transitions between barrier types

Where two different types of barrier meet, it is necessary for a transition treatment to be constructed at the junction of the two barriers. For example, to connect a W-beam (semi-rigid) barrier to the concrete (rigid) barriers on a bridge requires a transition element stiff enough to ensure that a vehicle sliding along the deforming semi-rigid barrier does not suddenly become snagged on the unforgiving rigid barrier. The transition piece in this case is formed by a progressive stiffening of the W-beam for a short distance leading up to the rigid barrier. The additional stiffness is generated by closer spacing of support posts and nesting of two layers of W-beam. These features are shown in Figure 24.

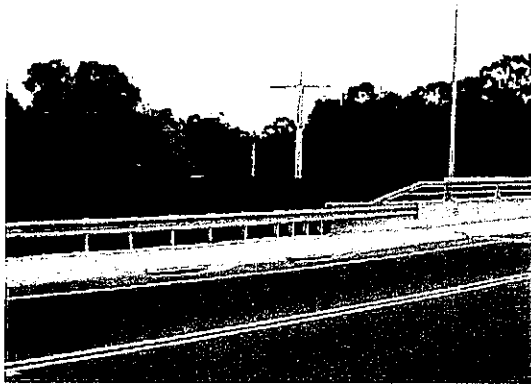


Figure 24: Semi-rigid (W-beam) to rigid barrier (bridge barrier) transition

A transition between flexible and semi-rigid barriers can be constructed by overlapping the flexible barrier in front of the semi-rigid barrier. A vehicle sliding along the flexible barrier will be travelling in a reasonably straight line and, at the end of the flexible barrier, will continue to slide along the semi-rigid barrier.

A transition from flexible to rigid can be achieved in a similar manner, by overlapping the departure end of the flexible barrier with the start of the rigid barrier. The posts of the flexible barrier will need to be positioned closer together on the approach to the rigid barrier to reduce deflection and thereby prevent a vehicle colliding with the end of the rigid barrier.

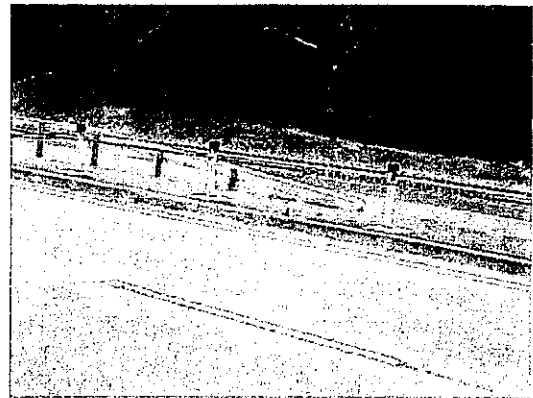


Figure 25: Wire rope safety barrier used as a median barrier – in transition with square hollow barrier

3.4 Works zones

During works on or near a roadway, protection of workers needs to be ensured, as well as maintaining a safe environment for pedestrians and motorists. The purpose of any temporary safety barriers at a works zone is therefore to redirect errant vehicles, preventing them from entering the works area, and minimise injury to the vehicle's occupants.

Safety barriers for works zones are designed to be portable, providing for quick installation and removal or relocation.

Works zone barriers may be necessary for a number of reasons:

- preventing vehicles from driving into works areas
- separating opposing flows of traffic on a temporarily constricted carriageway

- protecting incomplete structures from vehicle impact
- reducing or eliminating the need for temporary reductions in speed limit.

The decision to install temporary safety barriers at works zones must be made as part of a full assessment of the traffic management needs of an individual works zone. Such an assessment must be made in accordance with the *Tasmanian Code of Practice for Traffic Control at Works Sites* (DIER 2004). Practitioners should refer to that document for guidance in this area.

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Onshore Seismic Survey Traffic Management Plan
Great South Land Minerals Ltd



Appendix E:
DIER G2 Contract Management Plan

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DEPARTMENT of INFRASTRUCTURE, ENERGY and RESOURCES, TASMANIA
GENERAL SPECIFICATION
G2 – CONTRACT MANAGEMENT PLAN

February 2005

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G2.1 SCOPE

This specification sets out the requirements for the Contract Management Plan that shall include the following elements as appropriate for the Contract:

- Environmental Management
- Quality
- Occupational Health and Safety
- Traffic Management
- Public Contact
- Durability and Life Assurance Plan and Procedures
- Maintenance Procedures for the Defects Liability Period.

Aspects to be included are specified in the relevant Australian Standards, Legislation and Regulations as well as this Specification

G2.2 SUBMISSION and APPROVALS**G2.2.1 Submission**

Two controlled copies of the Contract Management Plan shall be provided to the Superintendent within 14 days of the Notification of Contract.

G2.2.2 Approvals**G2.2.2.1 Use of land not in the Contract Site**

If the Contractor intends to negotiate with any landowner to use any areas outside the road reserve, or the Limits of Contract, for any reason, written authorisation to use that area shall be obtained from:

- (i) the Department of Primary Industry Water & Environment for Crown Land
- (ii) the relevant Local Planning Authority.

A copy of all correspondence shall be given to the Superintendent prior to any works proceeding.

Prior approval of the Superintendent shall be obtained where any site offices, sheds, stores, stock piles, dump sites or working areas are located within the limits of contract and/or the road reservation outside the Limits of Contract.

G2.2.2.2 Pits and Quarries

The Contractor shall provide to the Superintendent evidence of the existence of a licence from Department of Primary Industries, Water & Environment for any quarry or pit, to be used for the purpose of this contract, including any condition placed on that licence, prior to use of any material therefrom.

G2.2.2.3 Cartage over Council Roads

Where the Contractor wishes to cart materials over Council or privately owned roads, including those of semi government authorities, to or from the site for the purposes of this Contract, then the Contractor shall obtain and provide evidence to the Superintendent of approval for cartage from the owners prior to the commencement of work. Further, the Contractor shall pay any levies, tolls and maintenance costs required, to cover reinstatement of damage to, or premature ageing of, those roads, as required by the owners. The cost of meeting any such expenses shall be deemed to have been included in the lump sum or in the relevant rates tendered for the Contract.

G2.2.2.4 Traffic Diversions and Detours

Traffic diversion onto, or closure of, council, private or other Government Authorities roads shall not be permitted until a written authorisation has been obtained by the Contractor from the owners and other relevant authorities with a copy given to the Superintendent seven (7) days prior to use.

The Contractor shall be responsible for the maintenance and repair of any damage to these roads.

G2.2.2.5 Rail Crossings

If the Contractor wishes to gain access at any additional railway crossing points, the Contractor shall notify the Superintendent and make appropriate arrangements with TasRail for a temporary rail crossing licence.

Failure of TasRail to approve an additional crossing shall not be a basis of a claim against the Principal.

G2.3 ENVIRONMENTAL MANAGEMENT

G2.3.1 General

The Environmental Management shall be in accordance with:

- (i) the performance requirements of this Specification,
- (ii) the Tasmanian Environmental Management and Pollution Control Act and Regulations
- (iii) A.S. 14001 Environmental Management Systems Specification and
- (iv) A.S. 14004 Environmental Management Systems General Guidelines

G2.3.2 Environmental Site Meeting

As specified elsewhere the Contractor shall attend an environmental site meeting to ensure that there is full understanding of the environmental protection measures required.

G2.3.3 Noise

The Contractor shall take all practicable measures to minimise noise resulting from his activities. All construction equipment shall be fitted with noise suppressors or silencers of a type recommended by the equipment manufacturer.

Loud hailers shall not be used for routine site communications.

G2.3.4 Archaeological, Botanical and Heritage Features

Any tree or hedge trimming required for the works shall be kept to a minimum.

Where there are a number of trees, shrubs, hedges, grasses and other features both inside and outside the boundary which are to be retained, they shall be treated in accordance with Specification R75. These shall be shown on the drawings, flagged on site or nominated by the Superintendent at the site meeting.

All trees within the new property boundary shall be retained if they fall outside the extent of the earthworks unless otherwise specified. Unnecessary "tidying up" of the bush such as scraping and brush clearing shall not be permitted.

Any disturbance outside the limits of the earthworks as defined in Specification R22 shall incur a penalty of \$1,000 plus a portion of the following rates:

- | | | |
|-----|---|---------------|
| (a) | General areas | \$6,000 / ha |
| (b) | Rare plant areas as indicated by the Superintendent | \$30,000 / ha |

G2.3.5 Aboriginal Artefacts

Should any Aboriginal artefacts be uncovered by the works, the Contractor shall immediately stop works affecting the find site and inform the Superintendent who will arrange for a Consultant to collect, identify and map the artefacts.

G2.3.6 Protection Works

The cost of any environmental protection works such as silt traps or fences, required by other Authorities outside the limits of contract shall be the Contractor's responsibility.

G2.3.7 Topsoil

No topsoil shall be stockpiled on areas of botanical importance which are indicated by preservation fencing type 1 or 2 as defined in Specification R75.

Topsoil shall not be removed from the site.

G2.3.8 Run Off

Run off from areas affected by pollutants such as oil, grease and any other waste material that may adversely affect the area shall be contained and removed from the site.

Stream diversions and dirty run off shall be managed to the satisfaction of DPIWE.

G2.3.9 Hazardous Materials

The Contractor shall prepare incident control procedures to be adopted to identify and control any hazardous materials either found on site or if the site is contaminated by a spill.

G2.3.10 Site Quarantine

The Contractor shall ensure that no soil, organic matter or seeds are transported to or from the site. All earthmoving machinery shall be washed down before entering or leaving the site.

G2.3.11 Lighting of Fires

Fires shall not be lit for any purpose within the limits of contract or road reservation. Outside the road reservation the Contractor shall observe the Fire Service Act and Regulations and other statutory requirements including permission from the Department of Primary Industries, Water & Environment relating to the lighting of fires, and shall give the occupiers of adjoining properties at least 24 hours notice before any burning off is commenced.

G2.3.12 Blasting and Structurally Damaging Processes ◆

The Contractor shall be responsible for any damage to any structures or buildings on or near the site caused by his operations. Blasting shall not be permitted within 500m of a high pressure gas pipeline.

The zone adjacent to earth retaining structures shall be compacted to the same density as the remainder of the fill by use of light mechanical plant using layers of appropriate thickness.

Before using explosives or other processes (including vibrating rollers) with the potential to cause structural damage through ground vibrations, the Contractor shall conduct a survey of all structures which he deems may be subject to any adverse effect from the operation or which may give rise to any claim by an owner. As a minimum, this survey shall include all structures within 200 metres of proposed blasting or use of pile drivers, and 100 metres of proposed use of vibrating rollers of mass greater than 8 tonnes. The survey shall be carried out by a qualified building surveyor, architect or engineer who is covered by Professional Indemnity Insurance.

Ancillary structures such as out buildings, concrete and paved areas, services and vegetation (eg. large trees) shall be part of the main structure survey.

The report for each structure shall be on the forms supplied at Annexure G2.3 or similar. The submission of all reports to the Superintendent is a hold point for the commencement of all other works.

Payment for each report shall be at Schedule Item 8.02.

When blasting is required, the Contractor shall obtain the necessary licences and shall conform to the requirements of the State Explosives Regulations relating to transport, storage, handling and use of explosives. Use of explosives shall also be in accordance with the rules contained in A.S. 2187, Part 1 and Part 2.

The Contractor shall keep records of each firing, showing blasting pattern, quantity and type of explosive used, firing delay, date and time of detonation. Included shall be the quantity of explosives for each delay.

When blasting operations are being carried out, the road shall be closed and appropriate signs erected. Residents within a distance whereby they may feel the blast shall be informed and necessary precautions taken before setting off any blast.

G2.4 QUALITY

G2.4.1 Quality

The Contractor shall plan, develop and maintain a documented quality system in accordance with

- (i) the performance requirements of this Specification,
- (ii) Australian Standard ISO 9001, Quality Management Systems - Requirements.

G2.4.2 General

The Quality elements shall show how the Contractor intends to assure, and be able to demonstrate, that the requirements of the specification are met. No provision of the Contract Management Plan shall over-rule the requirements of the Specifications.

The Contract Management Plan shall describe the application of the Contractor's Quality System to the Contract, and shall include, in particular, details listed in the following clauses.

Project specific items listed in Annexure G2.1 are additional requirements which shall be fully described in the Contractor's Contract Management Plan.

G2.4.3 Inspection and Test

(i) Inspection and Test Plan

The contractor shall develop inspection and test plans (ITPs) as part of the Contract Management Plan.

(ii) Registered Laboratories

All quality control tests undertaken by the Contractor shall be performed by laboratories currently registered with NATA for the relevant test, and test reports shall be certified by a NATA accredited signatory.

G2.4.4 Control of Construction Processes

The Contractor shall detail procedures and/or work instructions for construction processes under the contract in the Contract Management Plan.

G2.4.5 Identification and Traceability

Recording systems shall be maintained to provide a traceable link between test data and the subsequent use of that data in the implementation of DIER specifications.

All test data shall be defined in terms of dates and precise locations.

The inspection and test plans shall define the system of recording and oversight of all test and calibration data. It shall cover test data for both incoming and outgoing products.

The Contractor shall maintain data and undertake such statistical analysis and prepare control charts as necessary to demonstrate process control and product compliance as defined in other parts of DIER Specifications. All such process control data shall identify the source of the test data in terms of date of test and test identification.

A registration system shall be implemented to control all calibration requirements, inspection and test plans, incoming and outgoing products, etc.

G2.4.6 Defective Work

The Contractor shall promptly notify the Superintendent of any product and service non-compliance, except where conformance is to be achieved by a continuation of the original process. Notification shall be submitted as a Notice of Non-Compliant Work and shall indicate the proposed method of rectification for approval by the Superintendent.

The Contractor shall use the standard form for Notice of Non-Compliant Work located in Appendix G2.4.

A hold point shall apply prior to covering up rectification work to allow the Superintendent to inspect the work.

G2.4.7 Superintendent's Audits

The Superintendent may carry out at any time an Audit of the Contractor's Systems. Such audits may include system or product compliance audits and require access by the Superintendent to the Contractor's offices, factories or site works.

Where the Superintendent's audit indicates nonconformance in a process or procedure, the Contractor shall submit a proposal for remedial action, for approval of the Superintendent.

Where the Superintendent's audit indicates a nonconformance in a test or measurement which would lead to failure of a lot or batch to satisfy specified requirements for acceptance, then the Contractor shall either:

- i) accept the Superintendent's tests or measurements, and hence submit a proposal for remedial action for approval of the Superintendent
- or ii) carry out repeat tests or measurements, which shall be subject to a process audit by the Superintendent. The results of the repeat tests or measurements shall be used for determining acceptance or otherwise of the lot or batch as defined in the Specification.

In the event that the repeat test or measurement confirms acceptance of the lot or batch by prior testing by the Contractor, with no additional work carried out thereon between the Superintendent's audit and the Contractor's retest, then the Contractor may seek reimbursement of the cost of the retest, and an extension of time if the activity concerned was on the Critical Path for the works.

G2.5 OCCUPATIONAL HEALTH AND SAFETY

G2.5.1 Occupational Health and Safety - General

Occupational Health and Safety provisions shall be in accordance with:

- (i) the performance requirements of this Specification,
- (ii) the Tasmanian Workplace Health & Safety Act and Regulations
- (iii) A.S. 4804 Occupational Health and Safety Management Systems.

This element shall demonstrate that the Contractor has assessed and understood the hazards and risks and has procedures in place to ensure that his Duty of Care to provide a safe workplace for his own workers, sub-contractors and the public during the execution of the Contract is achieved.

G2.5.2 Hazard and Risk Assessment

This element shall include an initial comprehensive hazard identification and risk assessment. In addition to this initial assessment attention is drawn to the requirement of the Regulations to maintain records of risk assessments throughout the Contract as work processes change on the site.

G2.5.3 Safety Management Plan

Tasmanian Workplace Health & Safety Act and Regulations require a Safety Management Plan, in a form approved by the Director, to be submitted to the Workplace Safety Division for projects over \$2million and may require it for smaller projects. Workplace Safety has 10 days to respond to that Plan. Work on site shall not proceed until Workplace Safety has approved the Safety Management Plan. The Safety Management Plan shall form part of the Occupational Health and Safety element of the Contract Management Plan.

G2.5.4 Incident Notification

The Contractor shall provide to the Superintendent, within 7 days of any accident / incident, a copy of the accident / incident report which must include remedial actions to avoid a recurrence of the accident / incident.

G2.6 TRAFFIC MANAGEMENT ◆**G2.6.1 General**

The Contractor shall:

- (i) Provide a safe work site for the public and site personnel at all times and in all conditions,
- (ii) Manage traffic flow through the site with delays and inconveniences held within the performance limits of this Specification.

Traffic Management shall be in accordance with:

- (i) The Tasmanian Traffic Act
- (ii) The Tasmanian Traffic (Road Rules) Regulations
- (iii) Traffic Control at Work Sites Code of Practice
- (iv) The performance requirements of this Specification,
- (v) AS 1742 Part 3 and AS/NZS 3845 and
- (vi) Australian Standard Safety at Roadworks handbooks.

The precedence of the documents shall be in the order as listed above.

G2.6.2 Site Plans

Traffic management for all work sites shall cover, as a minimum, the following:

- (i) Details in accordance with AS1742.3 - Section 2,
- (ii) Methods of communication,
- (iii) How the Contractor intends to provide advance warning to the public on delays/diversions ,
- (iv) The staging of works (marked up on plan overlays for each stage of the works),
- (v) How the Contractor proposes to open the site to clear traffic backup,
- (vi) The names and qualification level of all personnel to be involved in traffic control,

Annexure G2.2. and the Form of Tender indicate details of traffic management required at the time of tender.

Traffic volume data is included in Annexure G2.2.

Speed restriction zones shall only be imposed over the localised area as required.

G2.6.3 Site Classification for Traffic Management

Work sites, or each part of a work site where a different traffic management regime is employed, shall be classified as one of the following:

- (i) Critical Exposure Site
- (ii) Non Critical Site

Where the specification includes such a classification, it shall apply.

Where no classification is specified, the Contractor shall classify the site, or part, using the following criteria:

- (i) A Critical Exposure site is one at which Annual Average Daily Traffic exceeds 3,500 vpd (sum of two directions)
- (ii) A Non Critical site is one that is not Critical Exposure. However the requirements of Specification G2.6.5 may require that the site be classed as Critical Exposure.

G2.6.4 Critical Exposure Sites:

For these sites the traffic management shall also include the following:

- (i) Identification by name and mobile telephone number the person who shall be on site at all times during work, in continuous mobile telephone contact with responsibility for implementing the traffic management, monitoring performance achievement and having full authority to cease work or take other emergency action when the procedures do not achieve the performance requirements.
In areas outside mobile phone range either radio or satellite phone contact shall be provided.
- (ii) Special provision for local landowners and businesses and the nature and timing of personal contact to advise of the effects and how and to what extent special needs will be addressed.
- (iii) Information on how any adjacent works by other contractors or statutory authorities are to be coordinated. The Contractor is responsible for obtaining this information.
- (iv) The nature of actions to cover the contingency where procedures do not achieve the requirements of this Specification.

G2.6.5 Performance Requirements

The following requirements shall apply to "long term" work sites, as defined in AS1742.3 Clause 1.4 only.

A delay shall be defined as the actual stoppage time measured from the time at which the first vehicle is stationary.

The duration of stopping for any vehicle shall not exceed 15 minutes where there has been advance warning to the public.

Where there has been no advance warning, the Contractor shall ensure that a stoppage time of 8 minutes is not exceeded. Tenderers shall show how this will be achieved and if not, why not. The Contractor shall employ the method proposed at time of tender or such other method as is needed to achieve this performance requirement unless the tender indicated the requirement would not be achieved and the tender was accepted without amendment.

Advance warning shall be in the form of adequate signage stating "expect delays for the next km from (month/year) to (month/year)". The sign should also advise on alternative routes in association with the signs and devices specified at Section 3 of AS1742.3. These shall be installed at least 7 days prior to work commencing. The signs shall be at each end of a contract or works site

Emergency services such as Police, Ambulance and Fire Brigades shall be advised in writing at least 7 days prior to any planned event likely to cause delays. Emergency contacts are listed on Annexure G2.2.

All media advertisements for traffic delays/diversions will be arranged by the Superintendent on the advice of the Contractor. The Contractor shall provide all details at least 7 days prior to the delay / diversion, together with evidence of all the relevant owner / authority approvals.

G2.6.6 Records

The Contractor shall comply with the guidelines and procedures set out in Appendix A of AS 1742.3.

G2.6.7 Devices

G2.6.7.1 Rotating Yellow Lamps

All construction vehicles being used on the work site shall have activated cab-mounted yellow rotating lamps fitted with a minimum 50w Halogen bulb.

G2.6.7.2 Fixed Multi Message Signs ◆

Fixed multi message signs may be used in accordance with all other requirements of this Specification, Specification R63, The Code of Practice and the following:

- (i) They shall only be used as a temporary sign during daylight working hours.
- (ii) Size shall be minimum 1200 mm x 900 mm.

- (iii) Maximum of three (3) logically linked messages per sign with one minimum 600 mm x 600 mm message plate symbolic.
- (iv) There shall be no conflicting messages used.
- (v) Speed plates shall always be closest to traffic mounted beside the other plate.
- (vi) Colours and Legends shall be in accordance with AS 1742. A road safety message may be white on a blue panel using class 2 sign material.
- (vii) Signs may be double sided.

G2.6.7.3 Traffic Controllers ♦

All personnel involved in traffic control shall have valid current accreditation having attended a recognised Traffic Management course for the relevant level of traffic control.

G2.6.7.4 Delineation of the Traffic Path ♦

Delineation of the traffic path shall be in accordance with AS1742.3. Star pickets shall not be used within 1.2m of traffic.

G2.6.7.5 Work Site Protection ♦

A safe work site shall be provided by the provision of physical separation and protection from traffic where possible. Energy absorbing devices shall be utilised to protect workers at lane closures, or slow moving mobile work sites unless the Contractor can demonstrate that the risk to workers has been adequately addressed by alternative means.

Slow moving mobile work sites are works travelling at 30km/h or less.

Energy absorbing devices include truck-mounted attenuators and temporary road safety barriers.

G2.6.8 Side Tracks

G2.6.8.1 Standard of Side Tracks

Further to AS1742.3 all sidetracks shall:

- (i) Be designed in accordance with AUSTROADS Rural Road Design Guide 1989. Sidetracks in use for more than one week shall be sealed and line marked with temporary pavement markings in accordance with Specification R64.

At least two (2) weeks prior to the construction of the sidetracks the Contractor shall submit to the Superintendent detailed drawings of the proposed sidetracks including all signs and linemarking. Linemarking details shall cover existing and temporary linemarking and the removal of conflicting and temporary linemarking.

The submitted drawings shall have been certified by an Engineer experienced in road design, who has qualifications admitting to Corporate Membership of the Institution of Engineers, Australia.

The submission of the drawings of the sidetracks to the Superintendent does not constitute approval of the design and shall not in any way relieve the Contractor of the responsibility for the satisfactory performance and adequacy of the sidetracks.
- (ii) Have a lateral clearance of at least 1.2 m from any obstruction. In difficult situations, however, the Superintendent may authorise a reduced clearance with an absolute minimum of 600 mm.
- (iii) Have a maximum grade of 6 percent.
- (iv) Be not less than 7 m wide if intended for two lanes of traffic and not less than 3.5 m wide if intended for single lane, one way traffic.
- (v) The design shall provide for a minimum drainage opening as specified elsewhere, or if not specified, a minimum of a one year flood capacity including any necessary rock pitching.
- (vi) Be completely removed and the area reinstated when the works are completed.

G2.6.8.2 Payment for Side Tracks

Where a sidetrack is required by the Specification, payment for the design, construction, maintenance and removal of the sidetrack shall be as per the item in the Schedule of Rates. Where a sidetrack is not required by the Specification, the cost of the design, construction, maintenance and removal of the sidetrack shall be deemed to have been included in the rates for the other items in the Schedule.

G2.7 PUBLIC CONTACT

The Public Contact Element shall detail how the Contractor will communicate with the public and shall include consideration of:

- (1) Protocols for liaising with all stakeholders, including emergency services and the media.
- (2) Who should be consulted / informed.
- (3) Why should they be consulted / informed
- (4) What should be communicated.
- (5) When it should be communicated.
- (6) How it should be communicated.
- (7) Protocols for dealing with public complaints and feedback.

The Contractor shall not issue any information, publication, document or article for publication concerning the project in any media without prior approval of the Superintendent, which shall not unreasonably be withheld. The Contractor shall refer to the Superintendent any enquires concerning the project from any media.

G2.8 DURABILITY AND LIFE ASSURANCE PLAN AND PROCEDURES**G2.8.1 Durability and Life Assurance Plan and Procedures**

This section shall include relevant analysis and testing procedures to be adopted in the design and construction to demonstrate and assure the Principal that the element has been designed and constructed in accordance with the Specifications and that the specified design life and durability will be achieved for the pavement, structure or other element for which a design life is specified.

Documentation to demonstrate that the durability shall be achieved shall form part of the Records. Records shall include any necessary statistical analysis.

Evidence, from the supplier, of compliance with Specification G6 shall be included in the Contract Management Plan. Evidence shall include control charts, quarry inspection records, details of reference specimens, durability test records and production control plans. For pavement materials evidence shall include details identified in Specification R40.

G2.9 MAINTENANCE PROCEDURES**G2.9.1 General**

The scope of the maintenance requirements during the Contract and Defects Liability Period are identified in Appendix G2.1.

The inspection frequency and maintenance procedures necessary for the upkeep of the works for the duration of the Construction and Defects Liability Period shall be detailed in the Contract Management Plan. Within 14 days of the issue of the Certificate of Practical Completion the Contract Management Plan defects identification and remediation procedures and maintenance provisions, where required by the Contract, shall be reviewed and the amended Plan reissued. These shall include the planning, inspecting, reporting, monitoring, executing and controlling of the processes involved in each activity, and note how product verification is to be achieved.

G2.9.2 Works by Other Contractors

The Contractor shall be responsible for the liaison and co-ordination of his work with any other Contractors or Authorities working in the vicinity of any maintenance activities.

G2.9.3 Maintenance Contractor Responsibilities

Where a Maintenance Contractor has been engaged to maintain a section or region of the State Road Network that Contractor shall only be responsible for maintenance of those nominated activities, as advised by the Superintendent, which are within the Limits of Works under road reconstruction or road reinstatement contracts between the date of Possession of Site and the Date of Practical Completion of these contracts.

Following Practical Completion of these other contracts, the Maintenance Contractor will be responsible for maintenance on these contract sites except for minor omissions and defects that are the responsibility of the construction contractor. The Superintendent shall advise of the location, date of possession of site and the date of practical completion for these other contracts and defects nominated to be repaired by the construction Contractor at the issue of the Certificate of Practical Completion.

G2.9.4 Maintenance of Trafficked Surfaces

The Contractor shall maintain, for the passage of the travelling public, all trafficked surfaces in a safe, dust free condition for all users at all times, particularly overnight and during weekends and public holidays.

Any damage resulting from traffic or any other cause shall be made good at the Contractor's expense.

Should the Contractor not carry out this maintenance then, the Superintendent may carry it out and the cost, as determined by the Superintendent, shall be deducted from payment to the Contractor.

All costs associated with this maintenance shall be deemed to have been included in the rates of all items comprising the Schedule of Rates.

G2.10 Emergency Contacts

The Contractor shall provide a 24 hour emergency contact and call out service adequately covering the whole maintenance area or contract site included in the contract to meet the emergency response times in Specification R101 Emergency Requirements. The Contractor shall provide details of names, addresses and telephone contact numbers in the Contract Management Plan.

Any changes to the list provided shall be advised in writing to the Superintendent within 48 hours.

G2.11 HOLD POINTS

Definition: Those points beyond which the work shall not proceed without review and release by the Superintendent.

All hold points identified in the Specification, and in Annexure G2.1, shall be defined in the Contract Management Plan, including information to be supplied at the hold point and who shall be responsible for its approval.

The release of a hold point shall not relieve the Contractor of his responsibility to construct the works in accordance with the Specification.

Except where specifically amended in Annexure G2.1 the following conditions shall apply to hold points.

- the Contractor shall give at least 2 working days prior notice of the Hold Point
- all relevant test and verification results shall be available for inspection by the Superintendent at the time of the Hold Point
- the Contractor shall allow for one working day at the Hold Point for the Superintendent to attend the site and inspect the work and documentation.

The Contractor may initiate additional hold points if considered necessary.

The following hold points are identified in this Specification.

Ref	Description of Holdpoint	Nominated Work not to proceed
G2.4.2	Those specified in Annexure G2.1	
G2.2.2.1	Copies of correspondence with landowners prior to work on their land.	Work on land owned by others.
G2.2.2.1	Prior to siting site offices, sheds, stores or depots.	Site works
G2.2.2.1	Prior to establishing a stockpile in the road reservation.	Establishment of a stockpile in the road reservation.
G2.2.2.2	Prior to using a pit or quarry.	Supply of material from a pit or quarry.
G2.2.2.3	Prior to cartage over Council or private roads.	Cartage over Council or private roads.
G2.2.2.4	Prior to diversion of traffic onto Council or private roads.	Diversion of traffic onto Council or private roads.
G2.3.5	The finding of any Aboriginal artefact.	All work in the area of the find.
G2.3.12	Structural reports prior to commencing all other works.	All work likely to damage structures.
G2.4.4	Prior to changes to procedures and / or work instructions for construction processes.	Changes to procedures and / or work instructions for construction processes.
G2.4.6	Any product and service non-conformance	Works affected by the non-conformance
G2.5.3	Approval of the Safety Management Plan when required by Workplace Safety.	All work
G2.6.5	Prior to any planned delay or diversion of traffic	Delay or diversion of traffic
G2.6.8	Prior to the construction of a sidetrack.	Construction of a sidetrack.

ANNEXURE G2.1 - PROJECT SPECIFIC DETAILS

CONTRACT NO.

CONTRACT NAME:

ADDITIONAL CONTRACT MANAGEMENT PLAN REQUIREMENTSADDITIONAL SUPERINTENDENT'S HOLD POINTSMAINTENANCE REQUIREMENTS (G2.9)

	During Construction		During Defects Liability	
	Included	Not Included	Included	Not Included
<u>Sealed Pavement</u> Schedule of Rates Items	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> 5.19, 5.20, 5.22, 5.23	<input type="checkbox"/>
<u>Shoulders</u> Schedule of Rates Items	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> 5.21	<input type="checkbox"/>
<u>Traffic Facilities</u> Schedule of Rates Items	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> 6.09, 6.15, 6.27	<input checked="" type="checkbox"/>
<u>Drainage</u> Schedule of Rates Items	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> 3.37, 3.38, 3.39	<input checked="" type="checkbox"/>
<u>Vegetation</u> Schedule of Rates Items	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> 7.08, 7.16, 7.17, 7.18, 7.19	<input checked="" type="checkbox"/>

Where routine maintenance is required during the Defects Liability Period a quantity for the schedule items for the maintenance works must be provided in the payment schedule.

ANNEXURE G2.2 - TRAFFIC MANAGEMENT DETAILS

CONTRACT NO.
CONTRACT NAME:
.....

(i) TRAFFIC MANAGEMENT DETAILS REQUIRED AT TENDER☐

None

☐

- How delays of less than 8 minutes, without Advance Warning will be achieved
- Specification G2.6.5 - For all sites,

(ii) PEAK TIMES(iii) TRAFFIC VOLUME DATA(iv) EMERGENCY CONTACTS

Fire Services Tasmania	Ph: (03) 6230 8420	Fax: (03) 6234 1465
Ambulance	Ph: 1800 008 008	Fax: (03) 6230 8515
Police - Officer in Charge	Ph: (03) 6336 3933 (North)	Fax: (03) 6336 3887
	(03) 6230 2260 (South)	Fax: (03) 6230 2261
	(03) 6230 2837 (East)	Fax: (03) 6230 2760
	(03) 6434 5215 (West)	Fax: (03) 6434 5250

Note: Contractor is responsible for establishing boundaries between districts.

Contractor to advise (and to record) all Emergency Services at least seven (7) days prior to any planned event likely to cause delays.

G2 – CONTRACT MANAGEMENT PLAN
ANNEXURE G2.3 - SURVEY OF STRUCTURES

February 2005

Page 1

Contract No.:

Contract Name:

Address:

Date of Inspection:

Property Owner:

Present at Inspection:

(Name and Title)

Description and Age:

General Photo of Location:

Signed

.....
Inspector

*covered by Professional
Indemnity Insurance*

.....
Contractor

.....
Property Owner

Date:

G2 – CONTRACT MANAGEMENT PLAN
ANNEXURE G2.3 - SURVEY OF STRUCTURES

February 2005



Page 2

BUILDING CONSTRUCTION

Exterior Cladding

Brick <input type="checkbox"/>	Suspended slab <input type="checkbox"/>	
Block <input type="checkbox"/>	Timber <input type="checkbox"/>	
Weatherboard <input type="checkbox"/>	Other	
Applied Finish <input type="checkbox"/>	Support System	
Other	

Foundation Walls

Brick/Block <input type="checkbox"/>	Box / eaves gutters <input type="checkbox"/>	
Concrete <input type="checkbox"/>	DP's Steel / PVC <input type="checkbox"/>	

Interior Walls

Stone <input type="checkbox"/>	P/Board <input type="checkbox"/>	
Timber <input type="checkbox"/>	Timber <input type="checkbox"/>	
Roof <input type="checkbox"/>	Brick/Block <input type="checkbox"/>	
Steel Tray <input type="checkbox"/>	Hard Plaster/render <input type="checkbox"/>	
Tiles <input type="checkbox"/>	Other	

Other

Ceilings

<u>Floors</u> Slab on grade <input type="checkbox"/>	Plasterboard <input type="checkbox"/>	
	Timber <input type="checkbox"/>	

G2 – CONTRACT MANAGEMENT PLAN

February 2005

Hard plaster/render ☐

Other

Windows

Timber ☐

Steel ☐

Aluminium ☐

Other

Dampness

No Sign ☐

Minor Problem ☐

Major Problems ☐

Other

G2 – CONTRACT MANAGEMENT PLAN
ANNEXURE G2.3 - SURVEY OF STRUCTURES

February 2005

Page 3

BUILDING CONSTRUCTION

Trees (Yes/No)

Size

< 2 m height

☐

2 - 6 m height

☐

> 6 m height

☐

Future problems

☐

FOR EACH ROOM

4. Floor Plan

5. Ceiling Plan

6. Elevation of each wall

DRAWINGS

(Each drawing to have descriptions as required.)

GENERAL

1. Site Plan

2. Floor Plan (with all rooms numbered)

3. Elevations of all external walls.

Ancillary Structures

Site Drainage ☐

Concrete paths ☐

Asphalt paths ☐

Concrete driveway ☐

Asphalt driveway ☐

Retaining Walls ☐

Out Buildings ☐

Type (Brief Description)

.....

.....

Other

ANNEXURE G2.4
Notice of Non-Compliant Work

Notice of Non-Compliant Work No.

Contract No.:**Date Issued:****Contract Title:****Contractor:**

**To
Superintendent
Attention:**

Pursuant to the undermentioned clauses of the Contract Conditions, the Contractor notifies that the following is not in accordance with the Contract

namely;

Details of your proposed remedial action will be advised by

.....(signature)

Contractor

DISTRIBUTION:**PROJECT
MANAGER****SUPERINTENDENT****Reference
Clauses**

AS 2124 cl.30, 30.3

AS 4300

AS 4305

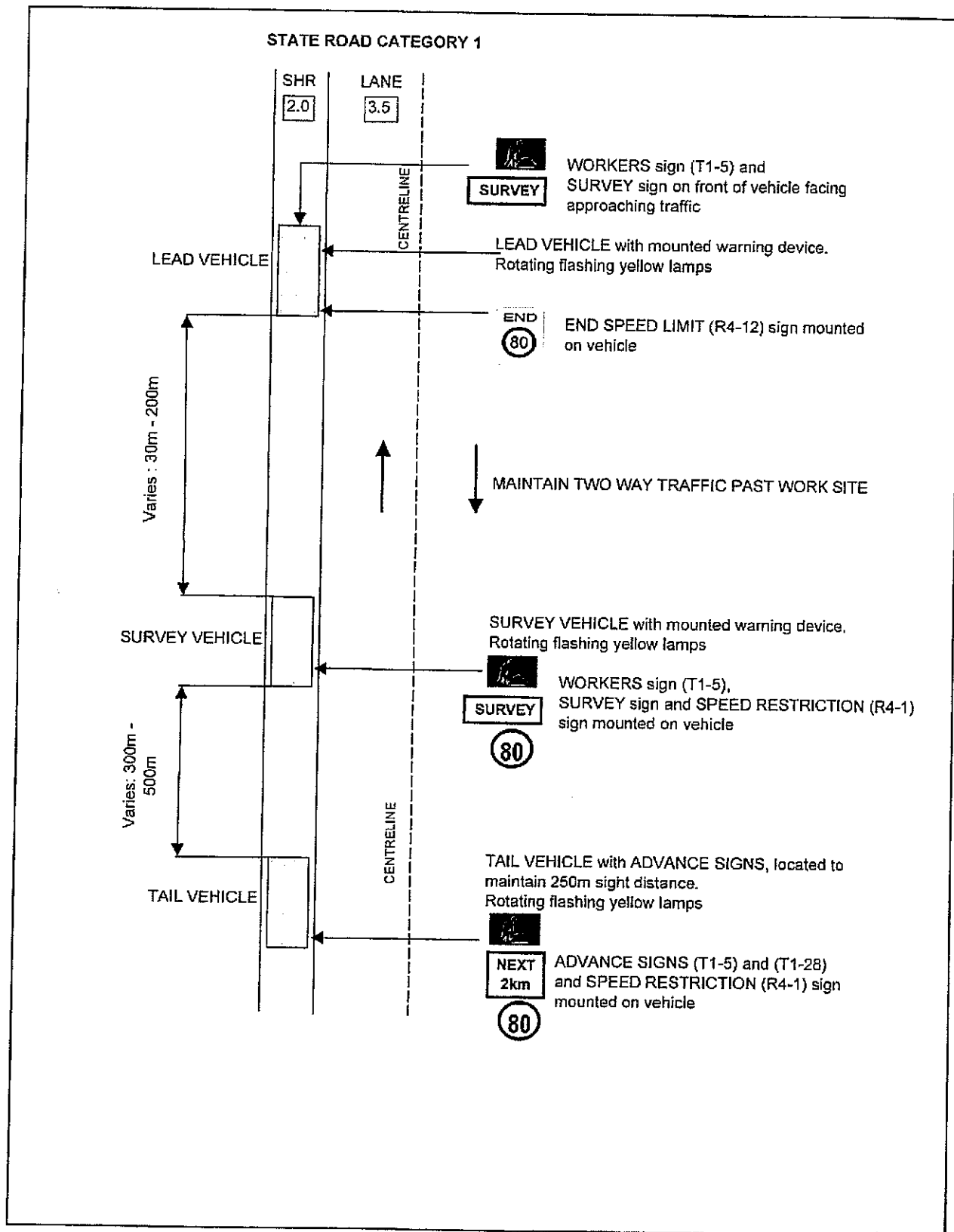


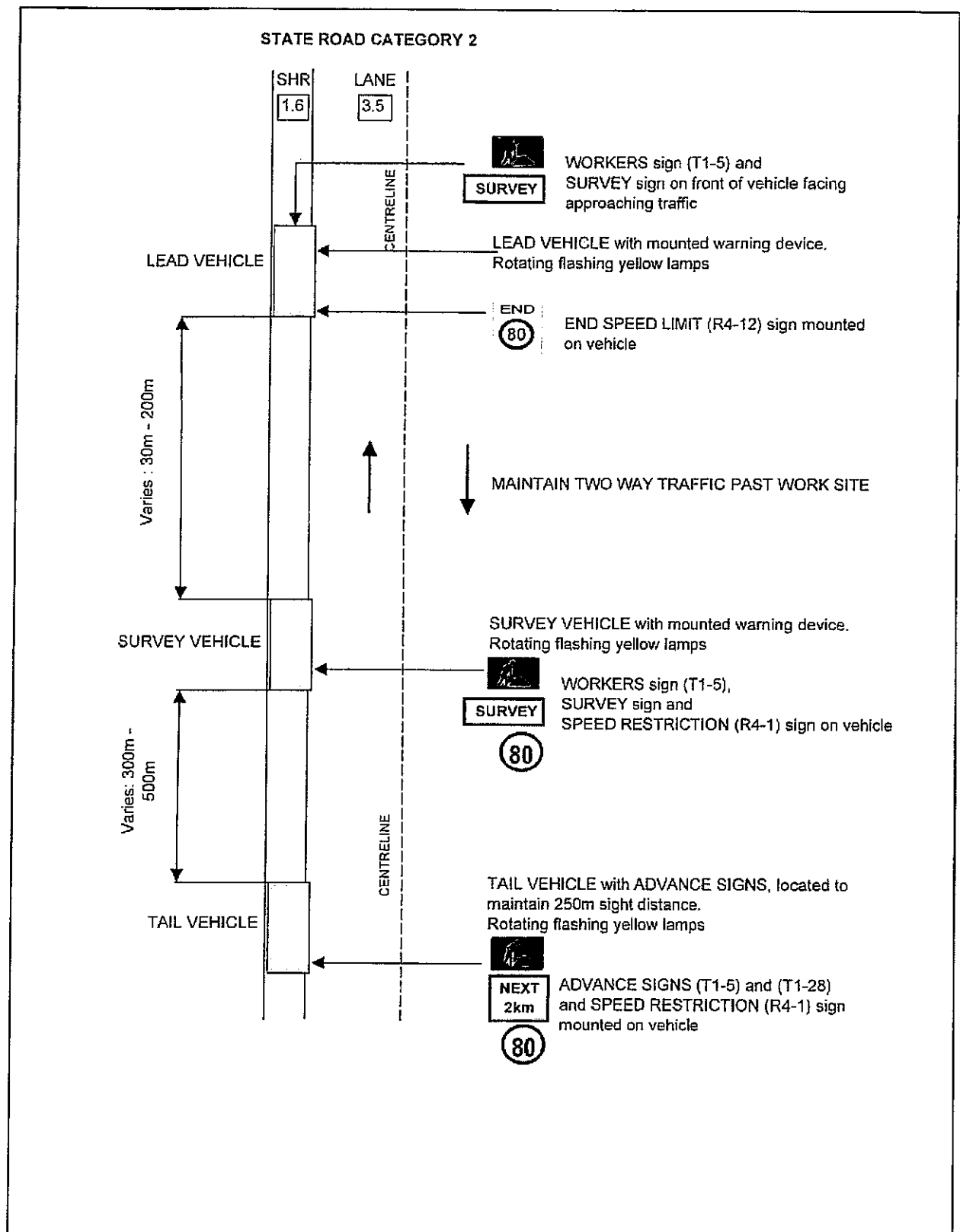
**Onshore Seismic Survey Traffic Management Plan
Great South Land Minerals Ltd**

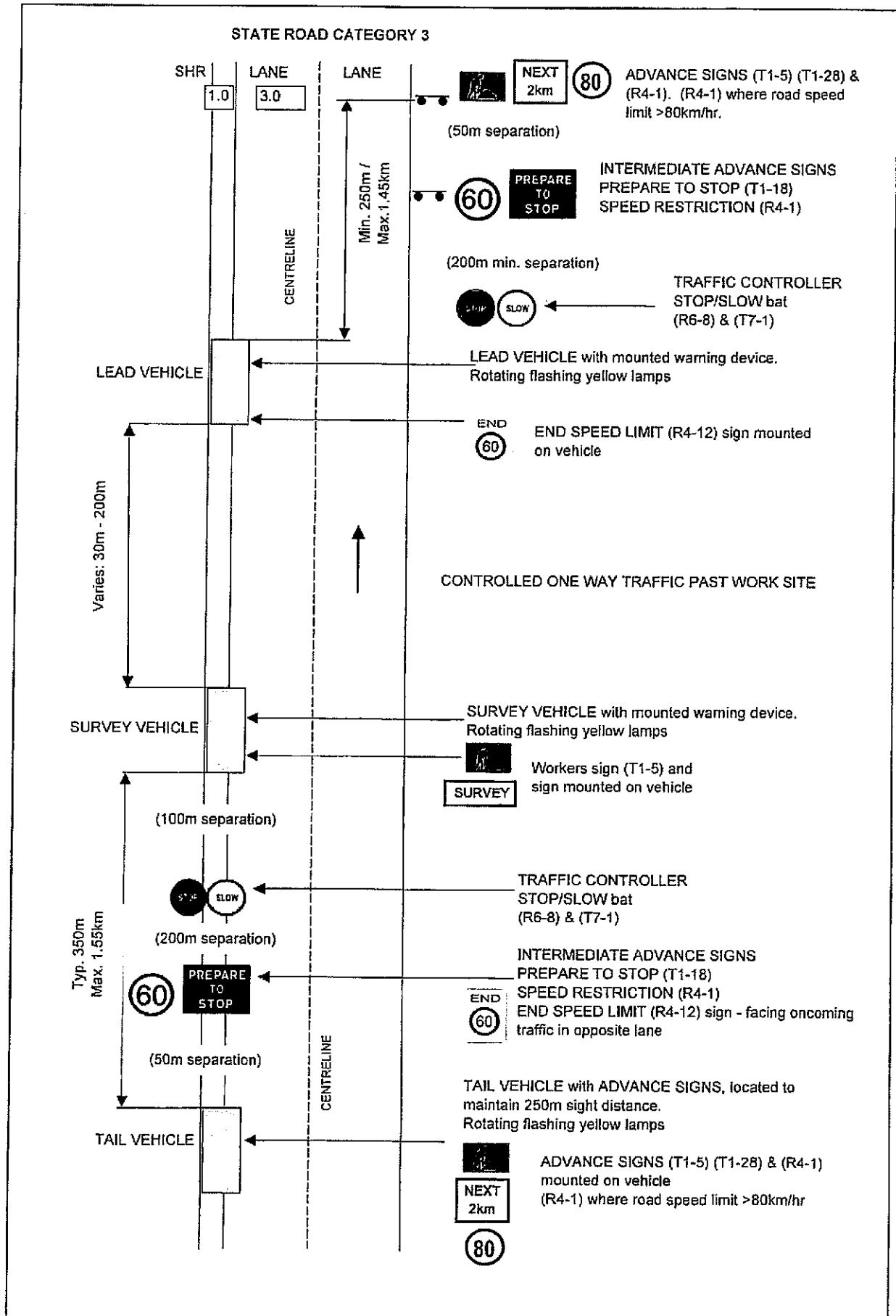


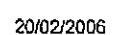
Appendix F:
TMP Signage Layouts

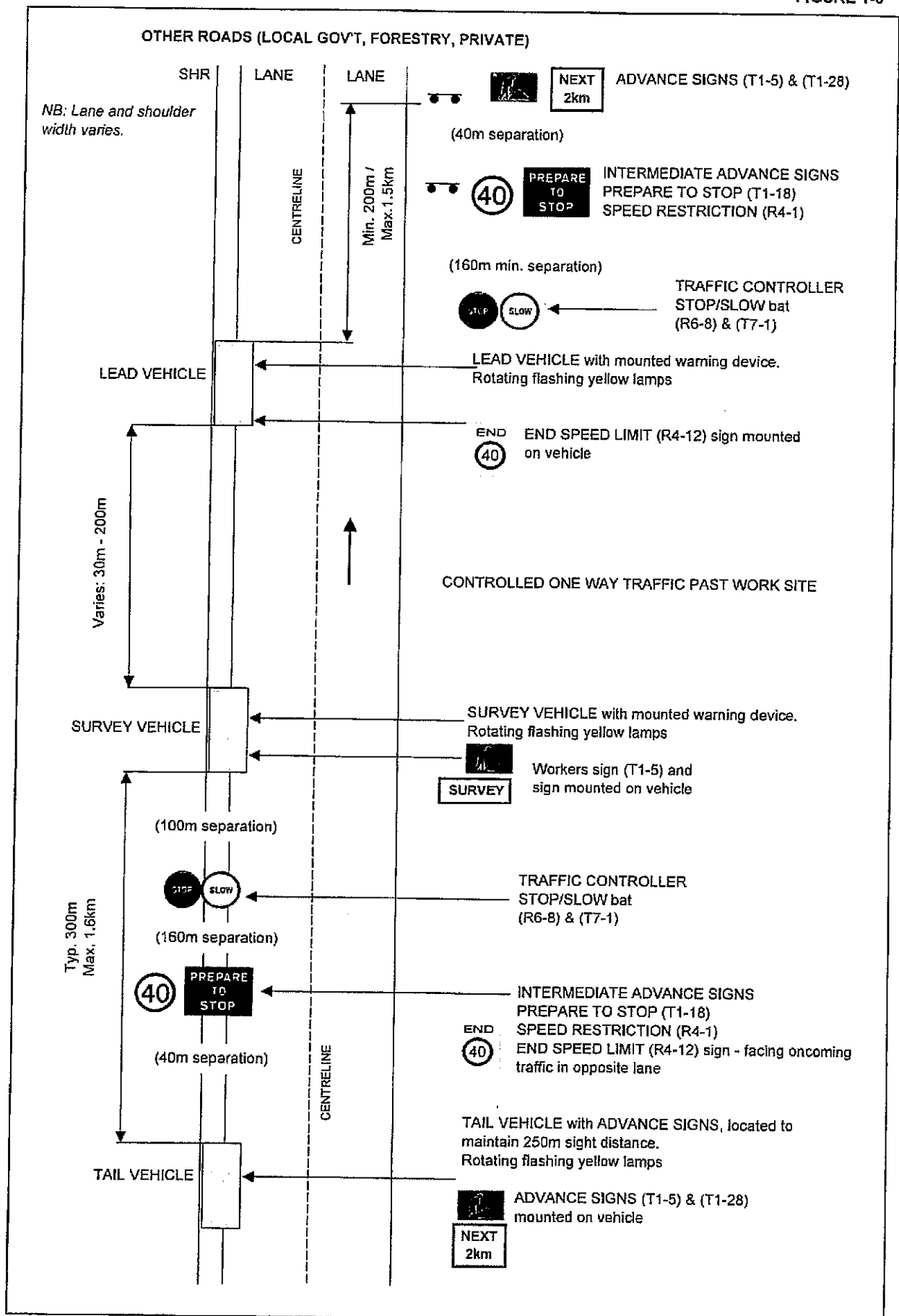
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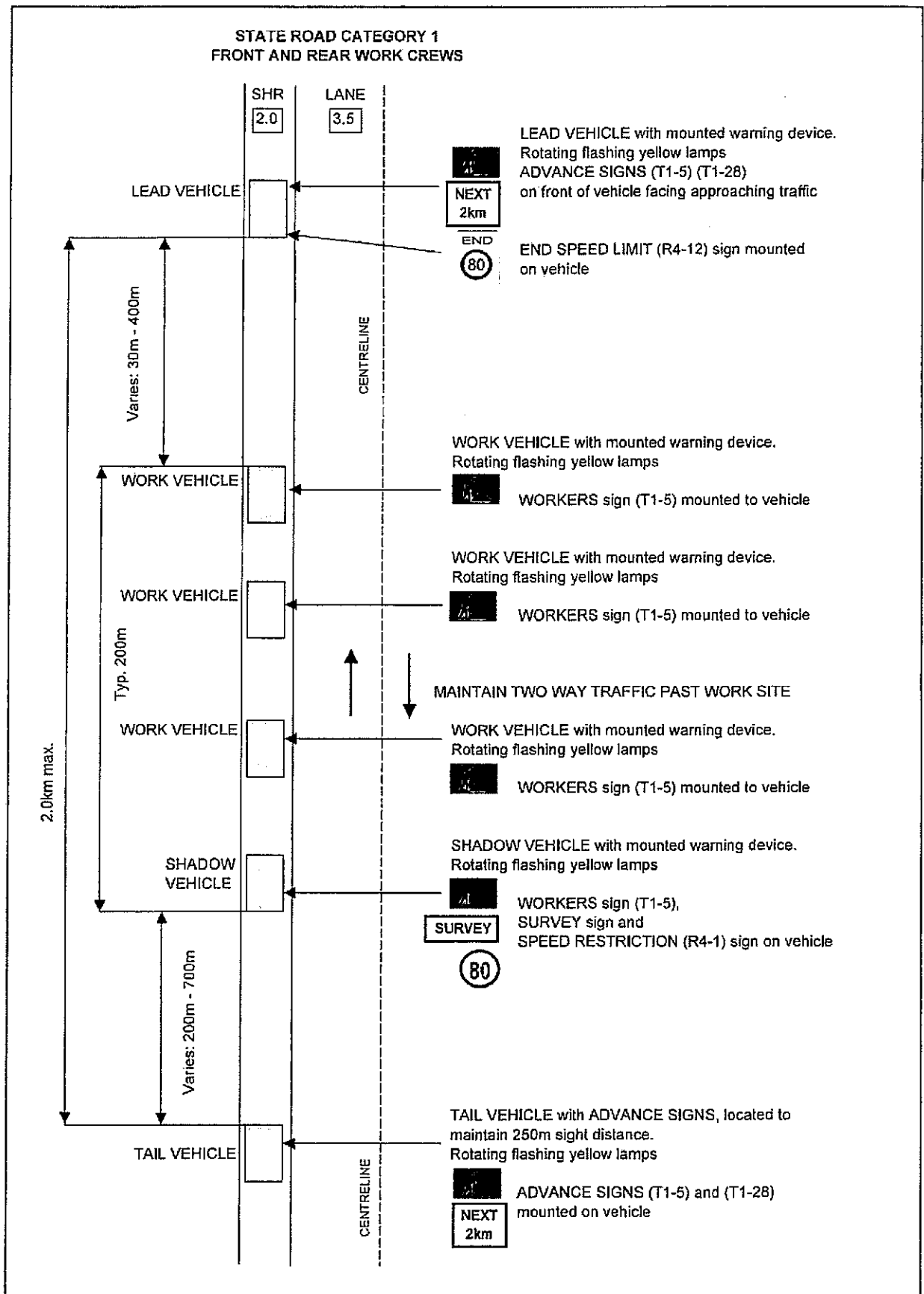


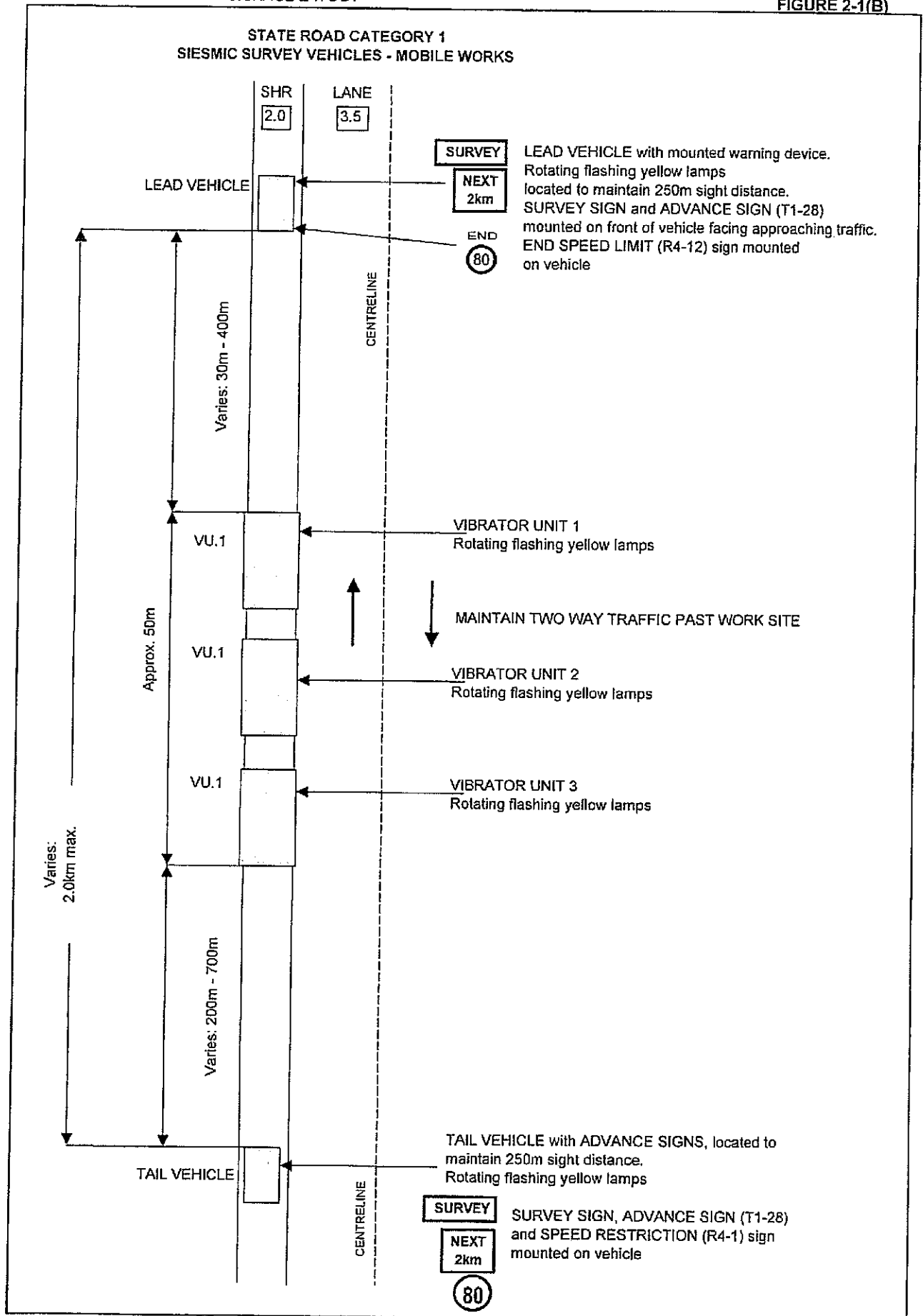


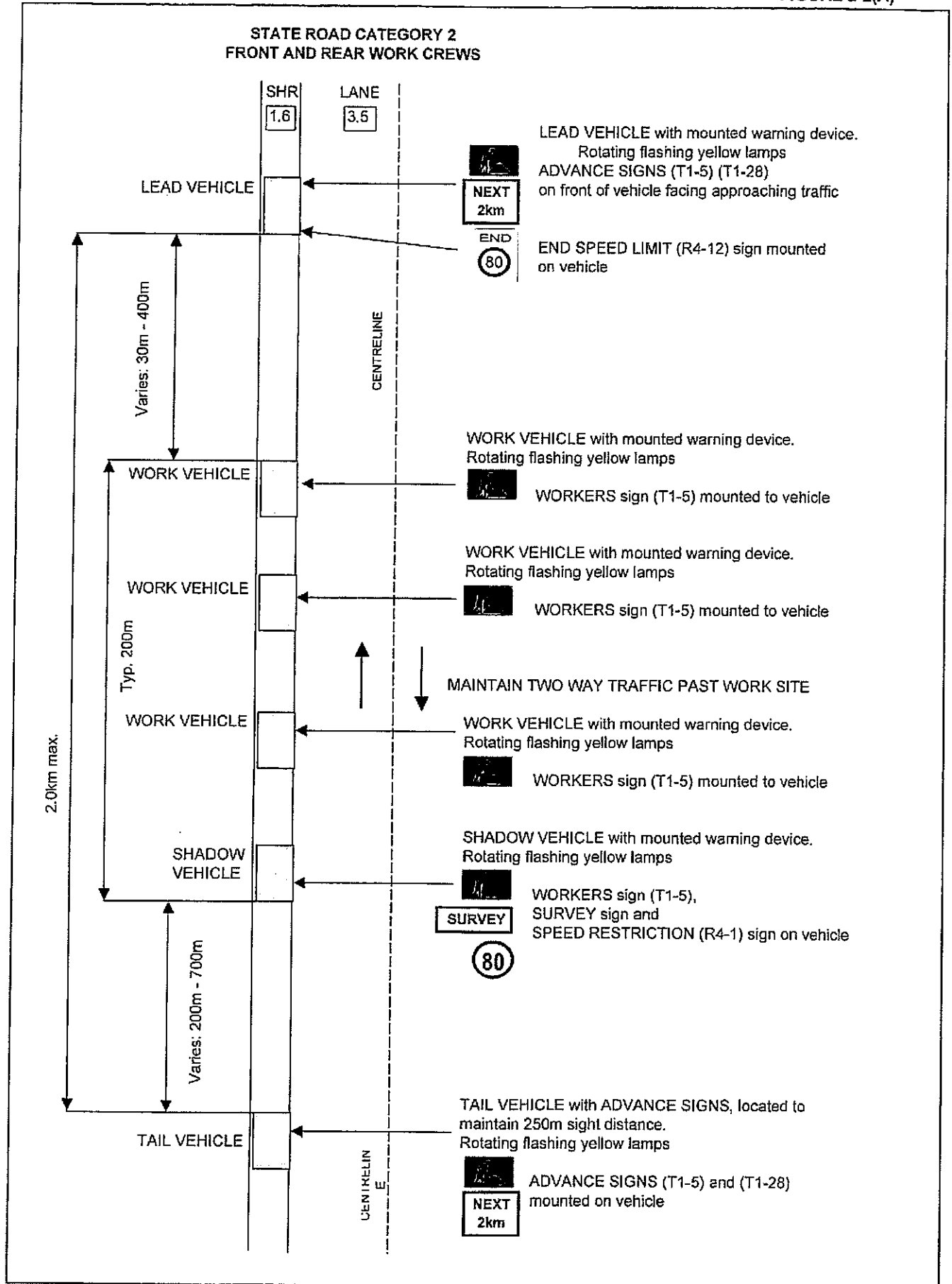


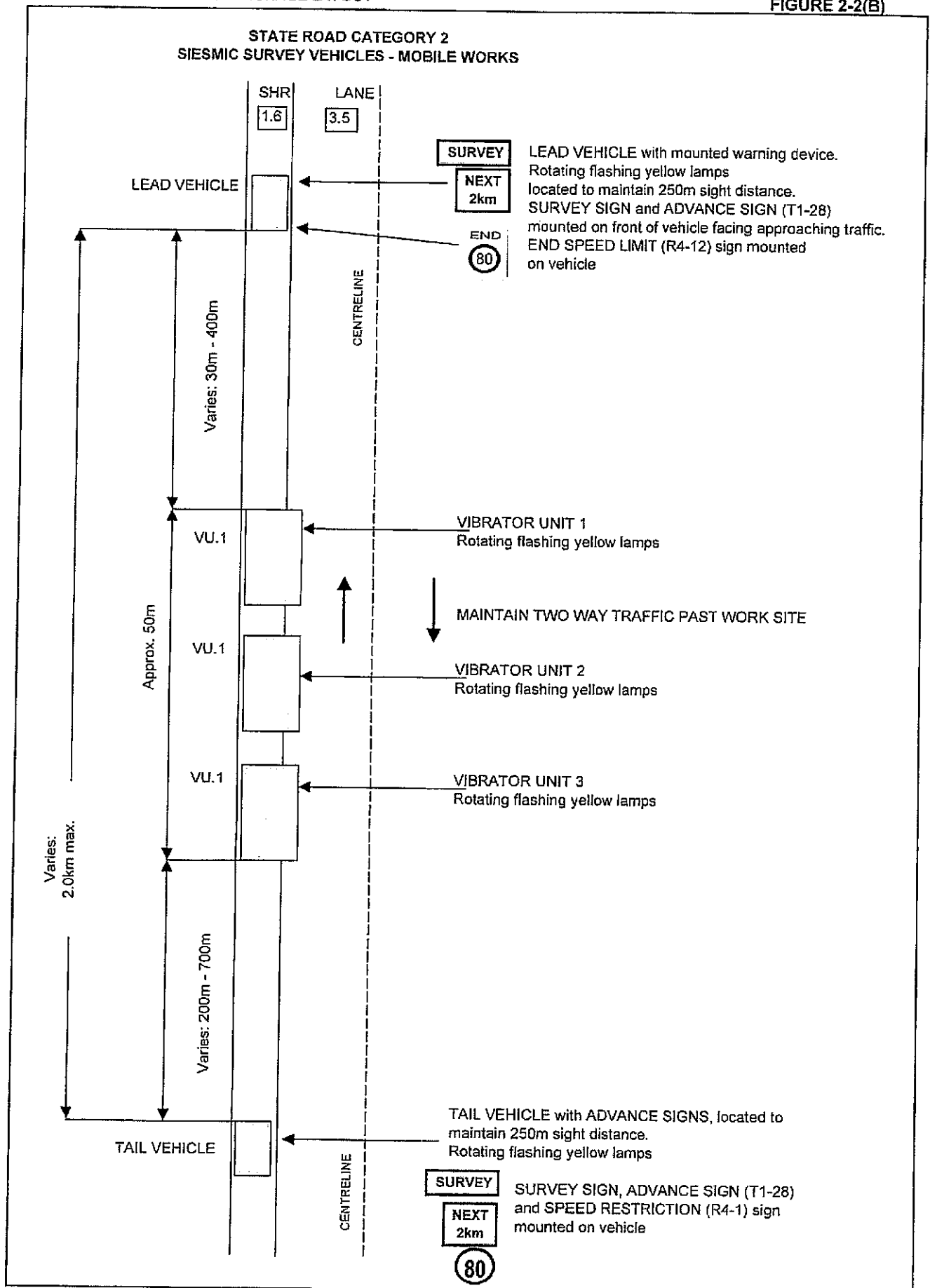


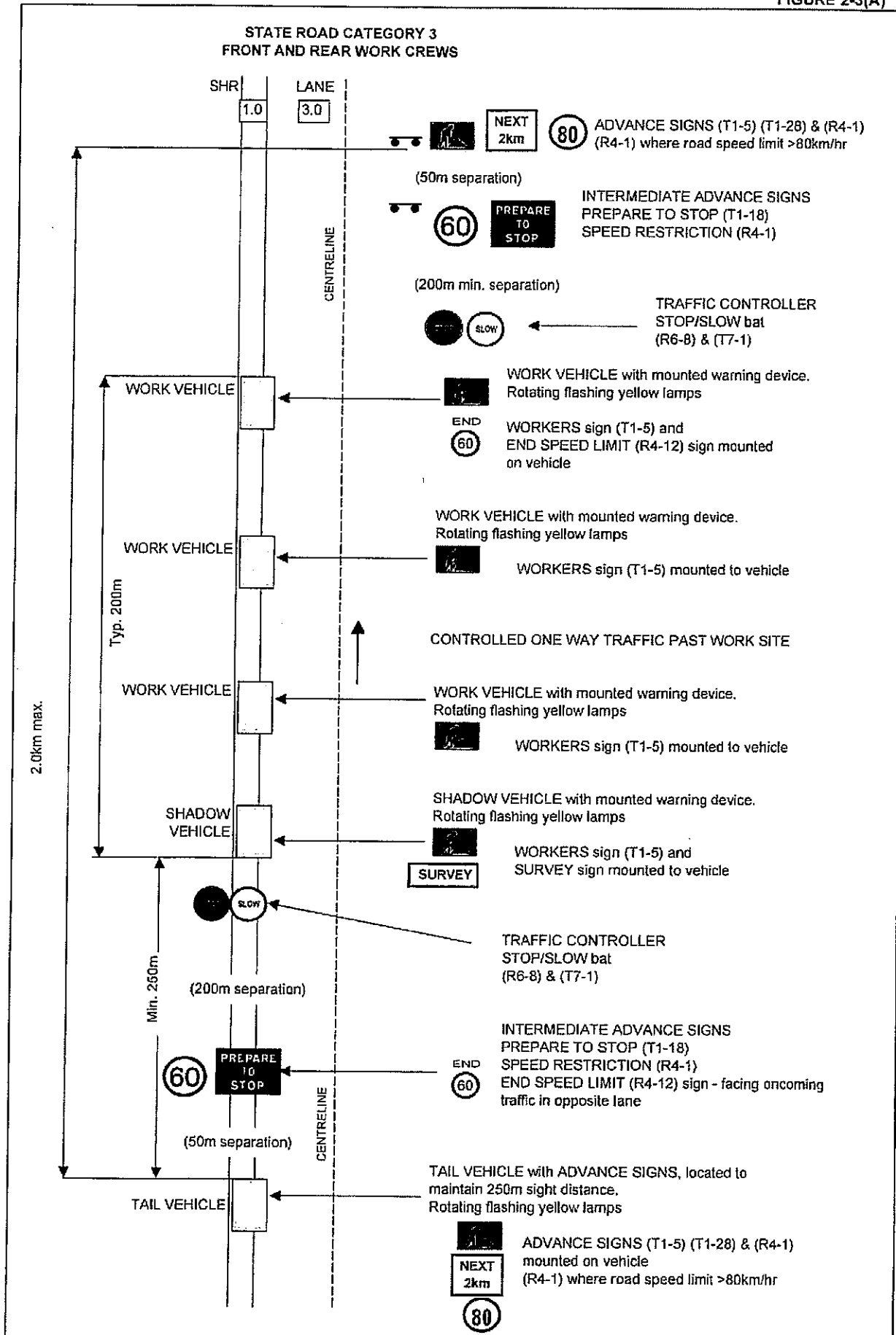


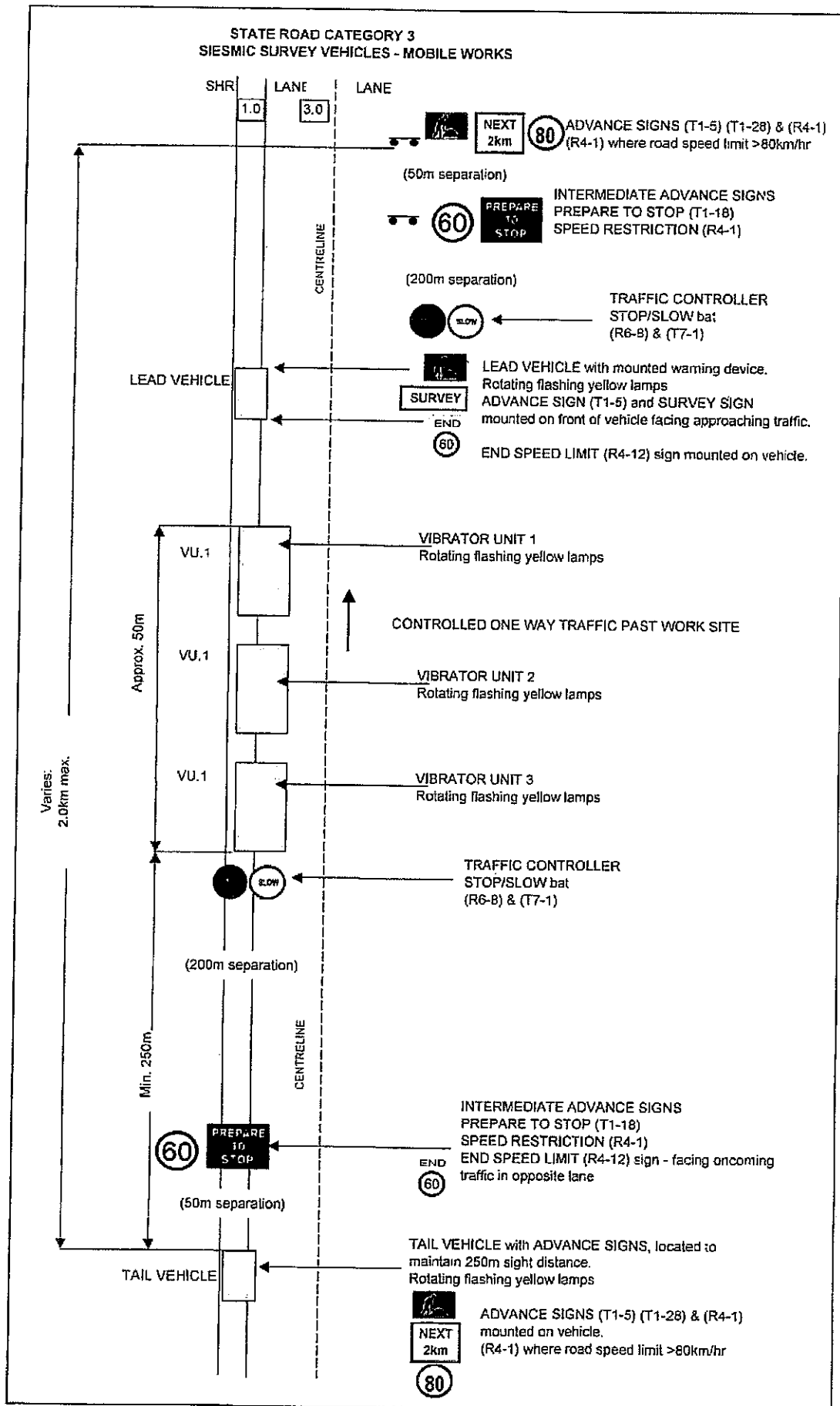


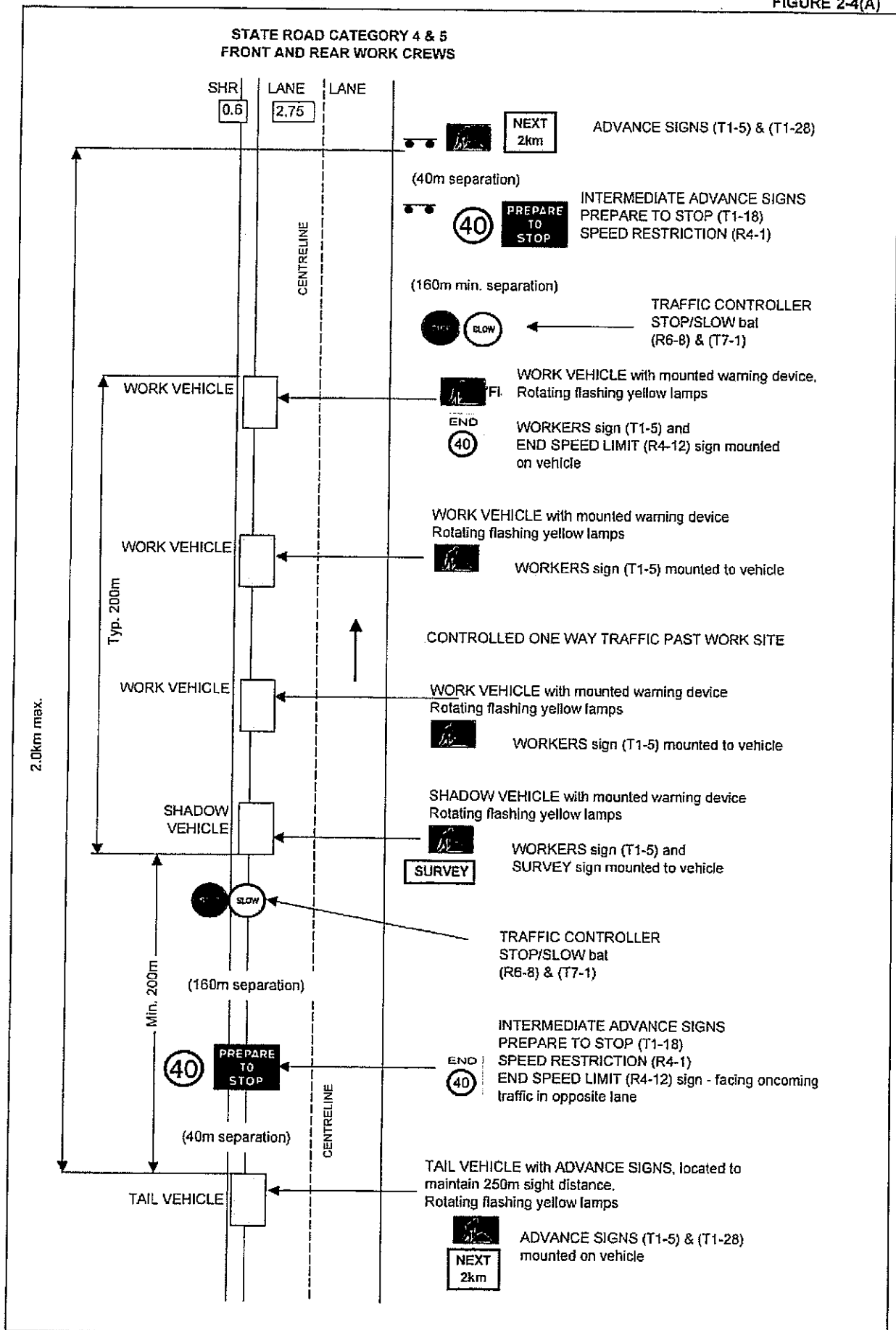


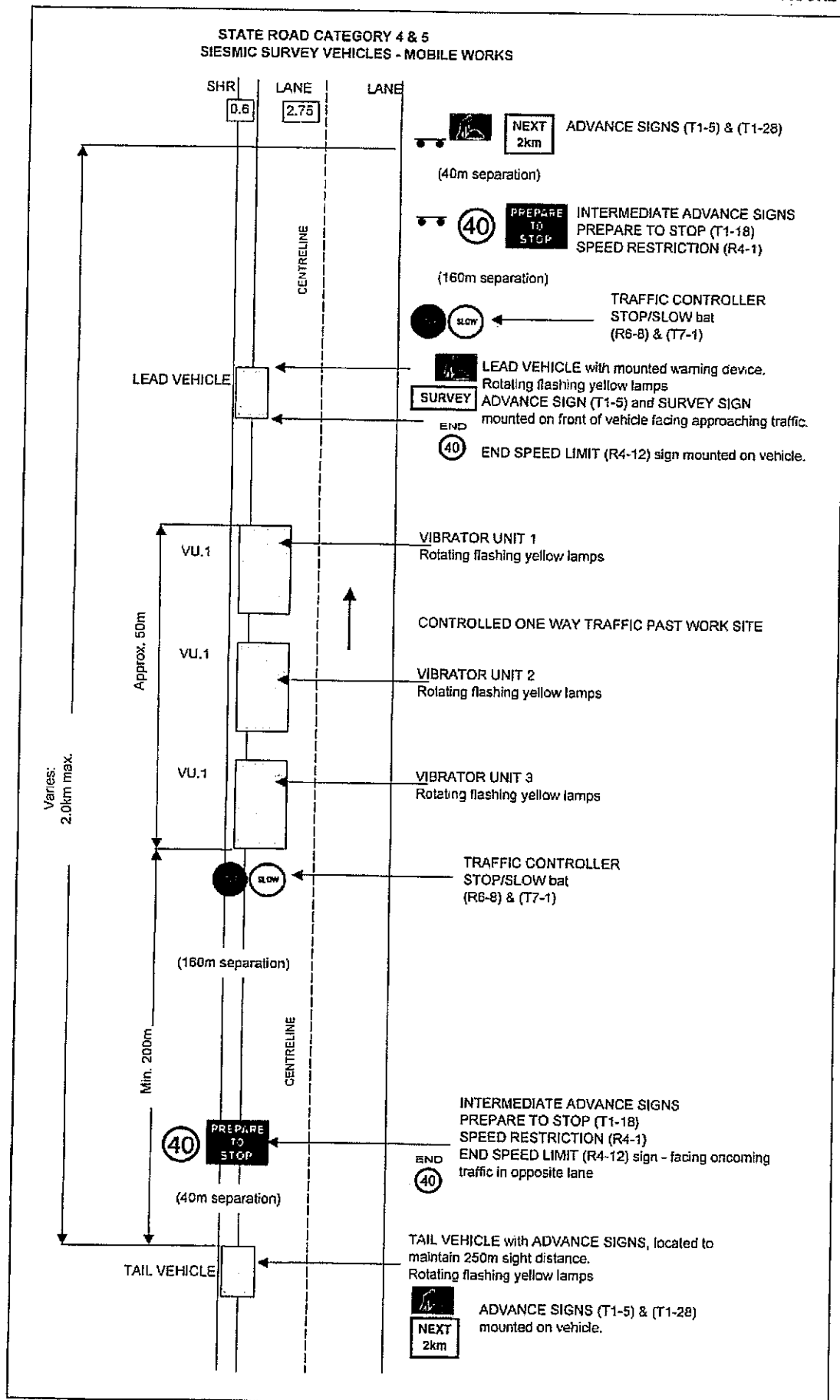


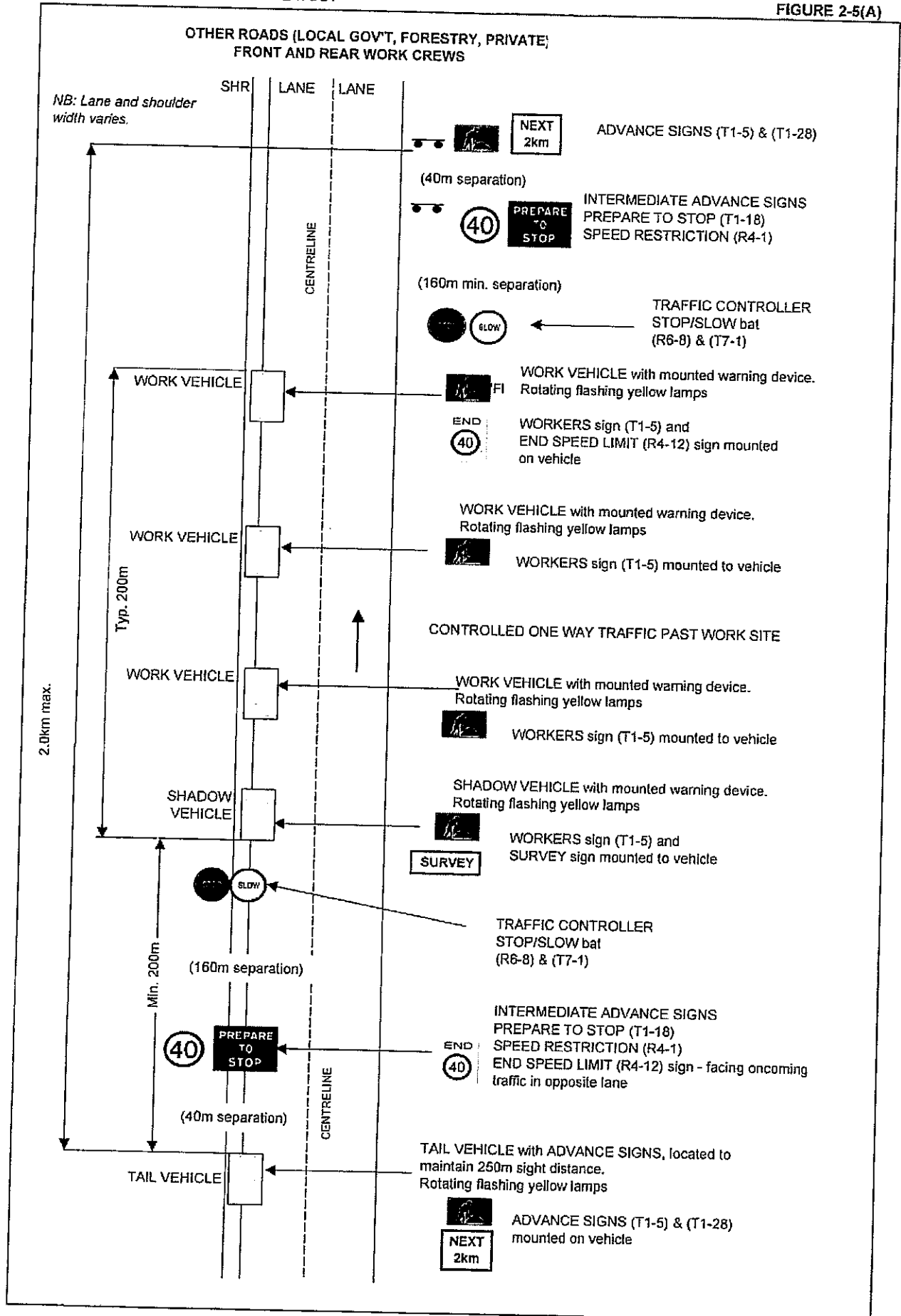


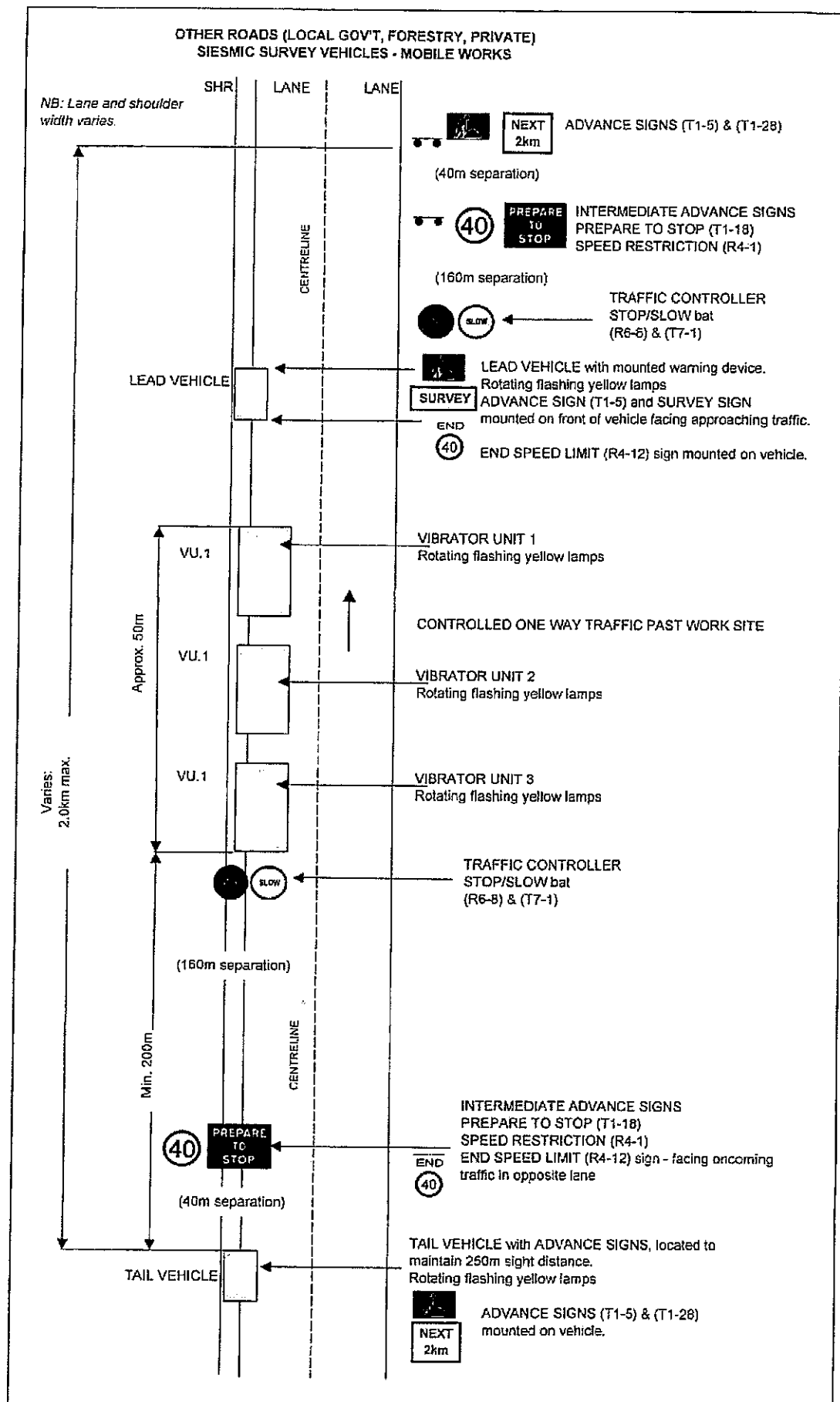












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**Onshore Seismic Survey Traffic Management Plan
Great South Land Minerals Ltd**



Appendix G:
Seismic Survey Risk Assessment

[]



Risk Assessment for Road Works

Purpose

Under the Workplace Health and Safety Act 1995, all employers have an obligation to ensure a safe working environment for their employees. Similarly, all employees are required to ensure their workplace is safe. This report has been commissioned to identify the hazards associated with conducting a mobile seismic survey on Tasmanian roads.

Method

The methodology used for this report follows the guidelines set out in Australian Standard for Risk Management AS4360:2004. All potential sources of injury, damage or environmental harm are identified (hazard identification) and a risk assessment conducted for each. Where serious risk is evident, risk control steps are taken to eliminate, reduce or manage the hazards. Relevant Australian Standards to assist in the minimisation of hazards and their consequences are referred to.

Hazard Identification

The following hazard identification and risk assessment technique is based on the scientific principle that in order to change a substances state energy must be applied and transferred. By looking for the energies present we are able to identify all sources of harm.

Great South Land Minerals Ltd
Traffic Management Plan Risk Assessment



<p>Muscular Movement, lifting, posture, strain, etc</p>	Climbing out of vehicles, walking, running, placing sensors in ground, removing sensors from ground, collecting sensors.	<p>Sound, Noise and Vibration</p>	Very low frequency from seismic trucks (7 to 25 Hz). Amplitude is unknown. Passing traffic, horns, etc
<p>Gravitational Falling things and falling people</p>	Fall from vehicle, fall into potholes/ditches/etc	<p>Kinetic Flying particles, dust</p>	Road dust, windy conditions
<p>Electrical AC/DC, static</p>	Very low voltage sensor equipment.	<p>Pressure Pressure vessels, pipes and vacuums</p>	Hydraulics on vehicles
<p>Thermal Hot and Cold</p>	Working in hot/cold temperatures.	<p>Biological Bacteria, virus, moulds, etc</p>	Snakes, spiders, etc
<p>Chemical Solids, liquids and gases</p>	Diesel fuel in trucks	<p>Radiation Sunlight, welding, uranium, heaters</p>	Sunlight
<p>Fire and Explosion</p>	Possibility of grass/bush fire	<p>Mechanical Machinery and Vehicles</p>	Passing traffic, moving trucks
<p>Hand Tools Drills, saws, hammers, etc</p>	None.	<p>Psychological Mental stresses, tiredness, etc</p>	Work hours, fatigue.
<p>Housekeeping</p>	None.	<p>Environmental Weather conditions</p>	Working in hot/cold temperatures, rain, snow, wind, etc



Risk Assessment

Each hazard presents its own risk profile, as some are inherently more dangerous than others. The purposes of a risk assessment is to determine the magnitude of risks presented by each hazard and prioritise risk treatment sequence. The following risk matrix was employed for this task.

		Worst possible consequence				
		Personal Injury	First-Aid Treatment	Medical treatment required	Extensive injuries, permanent disability, hospital admission	Fatality of 1 or more people
		Environmental impact	No adverse effects	Temporary adverse effects	Long term effects, actions from authorities, community complaints	Major impact, potential revoking of licence, media attention
		Property, plant and equipment damage	Less than \$2,500 damage	\$2,500 to \$25,000 damage	\$25,000 to \$250,000 damage	Above \$250,000 damage
Frequency (probability * exposure)	Rare Theoretically possible 1/1,000 years	Low Accept risk	Low Accept risk	Medium Workshop risk control measures		
	Unlikely Not seen, but foreseeable 1/100 years	Low Accept risk	Medium Workshop risk control measures	Medium Workshop risk control measures		
	Possible Have heard of it happening 1/10 years	Medium Workshop risk control measures	Medium Workshop risk control measures			
	Likely Has happened before 1 / year	Medium Workshop risk control measures				
	Certain Happens all the time 10 / year	Medium Workshop risk control measures				

Great South Land Minerals Ltd
Traffic Management Plan Risk Assessment



This process resulted in the following:

Hazard				Risk Controls
Climbing out of vehicle	First Aid treatment	Possible	Medium	Handrails and steps on vehicles to assist passengers.
Fall when walking/Running	First Aid treatment	Likely	Medium	Workers reminded to be vigilant while working on the road.
Placing sensors in ground	First Aid treatment	Likely	Medium	Examine method and suggest ways to reduce bending and excessive force.
Removing sensors from ground	First Aid treatment	Likely	Medium	Examine method and suggest ways to reduce bending and excessive force.
Collecting sensors	First Aid treatment	Likely	Medium	Examine method and suggest ways to reduce bending and excessive force.
Noise from passing traffic	Medical treatment	Possible	Medium	Workers should wear ear plugs or muffs.
Low frequency seismic trucks	First Aid treatment	Rare	Low	Workers should keep their distance from seismic trucks where possible.
Falling from vehicles	Medical treatment	Possible	Medium	Handrails and steps on vehicles to assist passengers.
Falling into potholes, ditches, etc	First Aid treatment	Likely		Workers reminded to be vigilant while working on the road.
Low voltage sensor equipment	First Aid treatment	Rare	Low	Ensure no higher voltages can make their way onto sensor equipment
Working in high temperatures	Medical treatment	Unlikely	Medium	Workers encouraged wearing lightweight, breathable materials, hats and sunscreen, drinking plenty of fluids, staying in the shade as much as possible and taking regular breaks.
Grass/Bush fire	Fatality	Possible		Fire extinguishers are to be readily available. Workers are reminded about smoking hazards and should keep alert to any dangers in the area. Maintain contact with emergency services.

Great South Land Minerals Ltd
Traffic Management Plan Risk Assessment



Hazard				Risk Controls
Working in low temperatures	Medical treatment	Unlikely	Medium	Workers encouraged wearing warm, water proof materials, gloves, raincoats etc. Take regular breaks in warm surroundings (trucks?) and eat regularly.
Diesel fuels	Medical treatment	Unlikely	Medium	No smoking near fuels, all fuels stored in suitable containers.
Road dust	First Aid treatment	Likely	Medium	Workers should be encouraged to wear safety glasses or facemasks where dust is a problem. First aid kits are to be equipped with eye wash.
Hydraulics on vehicles	Extensive injuries	Unlikely	Medium	Ensure hydraulic systems in good condition and are serviced regularly. Ensure no personnel are near hydraulic system when in operation.
Snake bite Spider bite	Medical treatment	Likely		Ensure first aid kit is available and all workers are trained in the treatment of venomous bites. Have a plan in place to treat victim and contact emergency services.
Sunlight	First Aid treatment	Likely	Medium	All workers are encouraged to wear long sleeve shirts and long trousers. Ensure all workers have access to sun hats, sunscreen and sun glasses.
Fatigue	First Aid treatment	Possible	Medium	Work hours are to be restricted to daylight hours and regular breaks should be taken.
Passing traffic	Fatality	Likely		Serious risk of fatality – see traffic management plan.
Moving trucks	Fatality	Likely		Serious risk of fatality – see traffic management plan.



Traffic Management Plan

The primary risk identified in this task is passing traffic and moving vehicles. As this presents a risk of fatality to workers, special care must be taken to ensure their safety. In this case normal traffic control methods are not practical due to the constantly mobile nature of the work.

The Australian Standard for Traffic Control Devices (AS1742) recommends the use of an Australian Standard AS4360:2004 (Risk Management) compliant risk assessment for continually mobile works. This report constitutes such an examination. The following risk treatment are designed to reduce the residual risks.

There are a number of factors in this case that reduce the likelihood of injury to workers:

1. Workers perform the majority of their duties on the side of the road, or in the surrounding land
2. Workers are protected from passing traffic by the seismic trucks and associated work vehicles
3. Seismic survey vehicles have flashing light bars to alert passing drivers to the hazards
4. Lead and trailing vehicles are equipped with road work signs and speed limit signs to warn passing motorists of the hazards
5. Workers never remain in relatively high risk areas for long periods due to the constantly moving nature of the work
6. Workers are required to wear high visibility clothing

In addition to these factors we also suggest the following:

1. Ensure vehicle operators are aware of workers presence, stay in view or contact at all times
2. Spotters should be employed to watch for traffic entering the site
3. Workers must ensure trees, shrubs, grasses, etc do not obscure the motorists view
4. If weather conditions jeopardise workers or motorist safety, work will be aborted and postponed until conditions improve.

Required signage

The following signs are recommended to complete the works as safely as possible:

Sign	Schematic	Sign Code	Size (mm)	Quantity
Reduce speed		G9-9B	1800x900	2
Workers		T1-5C	1800x1200	4
Temporary Hazard		T5-4	1500x450	7
Speed restriction		R4-1C	900x1200	1
Stop/Slow Bat		R6-8B T7-1B	600 diameter	3