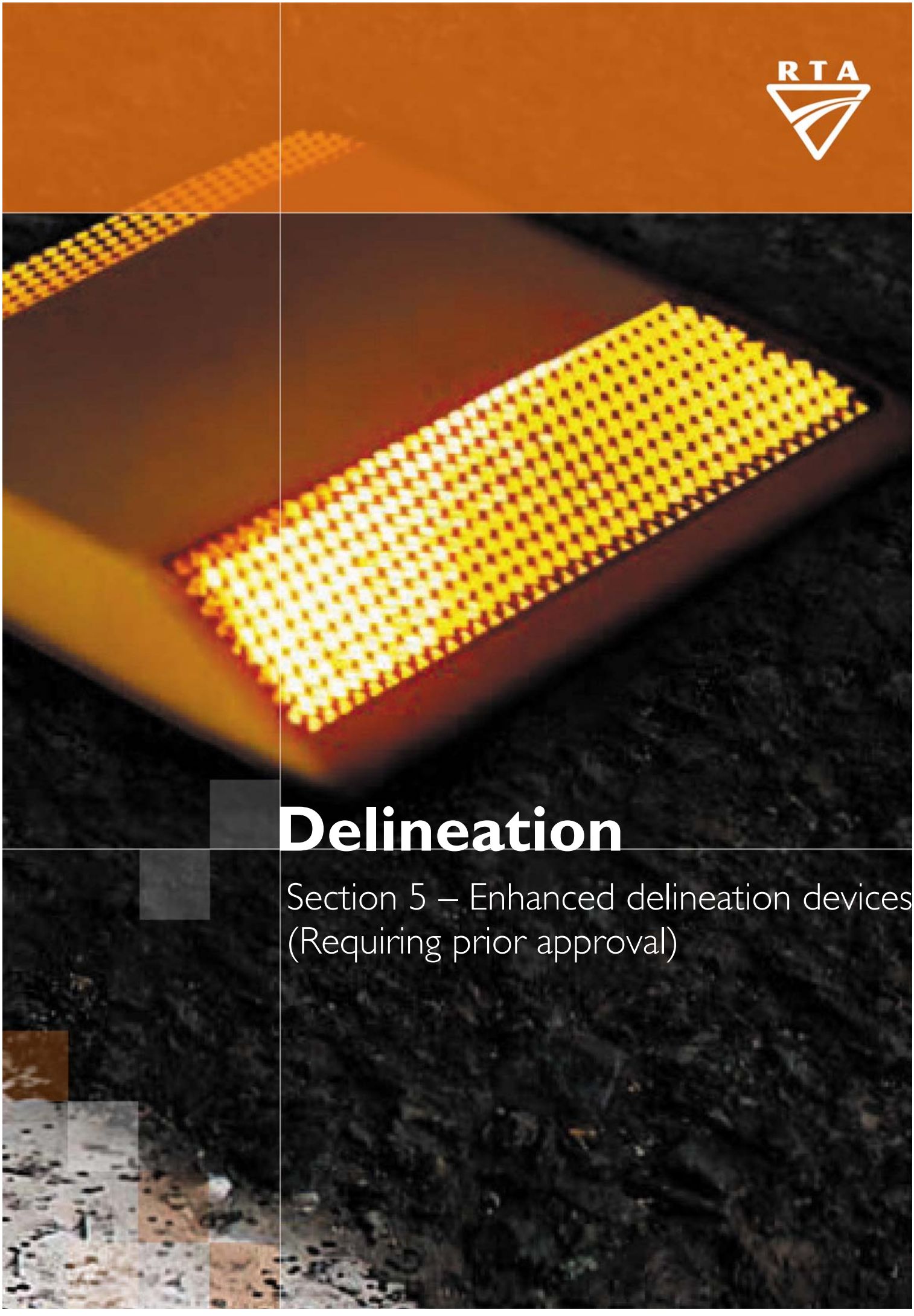

Delineation

Section 5 – Enhanced delineation devices (Requiring prior approval)

The delineation guidelines have been developed to assist in designing and maintaining a quality delineation system.

The guidelines are to comprise 19 sections and an appendix. These are initially being released individually and in no specific order. The sections which are to be released are as follows:

Part	Title
Section 1	Introduction
Section 2	Delineation principles
Section 3	Pavement markings
Section 4	Longitudinal markings
Section 5	Enhanced longitudinal markings
Section 6	Transverse markings
Section 7	Transverse markings - Pedestrian facilities
Section 8	Diagonal and chevron markings
Section 9	Messages on pavements
Section 10	Pavement arrows
Section 11	Pavement markings at roundabouts
Section 12	Pavement markings for bicycle facilities
Section 13	Pavement markings for kerbside parking restrictions
Section 14	Maintenance of pavement markings
Section 15	Raised pavement markers
Section 16	Guide posts and delineation of safety barriers
Section 17	Alignment signs and markers
Section 18	Delineation systems
Section 19	Delineation management and audit
Appendix A	Locating and setting out of dividing (barrier) lines

To determine which sections are currently available go to:

www.rta.nsw.gov.au/doingbusinesswithus/downloads/technicalmanuals/delineation_dl1.html

The information contained in the various parts is intended to be used as a guide to good practice. Discretion and judgement should be exercised in the light of the many factors that may influence the choice of delineation devices in any situation. The guidelines make reference, where relevant, to current Australian Standards and are intended to supplement and otherwise assist in their interpretation and application.

Delineation

Section 5

ENHANCED DELINEATION DEVICES (Requiring prior approval)

Special Note:

As from 17 January 2011, the RTA is adopting the Austroads Guides (Guide to Traffic Management) and Australian Standards (AS 1742, 1743 & 2890) as its primary technical references.

An RTA Supplement has been developed for each Part of the Guide to Traffic Management and relevant Australian Standard. The Supplements document any **mandatory** RTA practice and any complementary guidelines which need to be considered.

The RTA Supplements **must** be referred to prior to using any reference material.

This RTA document is a complementary guideline. Therefore if any conflict arises, the RTA Supplements, the Austroads Guides and the Australian Standards are to prevail.

The RTA Supplements are located on the RTA website at www.rta.nsw.gov.au

Roads and Traffic Authority
www.rta.nsw.gov.au

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APPROVED BY:

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To access electronic copies of these and other guidelines go to:

www.rta.nsw.gov.au/doingbusinesswithus/downloads/technicalmanuals/technicalmanuals_dl1.html

For the latest amendments (if any) to these guidelines go to:

www.rta.nsw.gov.au/doingbusinesswithus/downloads/technicalmanuals/delineation_dl1.html

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Contents

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Amendment record

Please note that the following updates have been made to this document.

Amendment No	Page	Description	Issued	Approved By
1	5-16	Requirement for approval in 5.3.2 clarified.	November 2009	R O'Keefe Mgr Policies & Guidelines
2	5-11	Profile line for other roads deleted	December 2010	R O'Keefe Mgr Traffic Policies, Guidelines & Legislation
3	5-26, 5-27	New Section 5.7 Enhanced Safety Barrier Delineation added	February 2012	R O'Keefe Mgr Traffic Policies, Guidelines & Legislation
4	5-26, 5-27	Width of delineation corrected	March 2012	R O'Keefe Mgr Traffic Policies, Guidelines & Legislation
5	5-26	New Section 5.7.5.3 Enhanced Safety Barrier Delineation – Central Concrete Barrier added.	May 2013	R O'Keefe Mgr Traffic Policies, Guidelines & Legislation

5.1 Special Approval

Standard delineation devices should be used on all RTA roads. However, in exceptional circumstances, there may be a case when enhanced delineation devices may sometimes be needed. Prior approval of the General Manager, Traffic Management is required for installing enhanced delineation devices prescribed in this section, except for the use of perceptual counter measures (Section 5.6), for which approval of the General Manager, Safer Roads, is also required.

5.2 Enhanced pavement markings

5.2.1 General

The following circumstances may warrant the use of enhanced pavement markings:

(a) To achieve greater separation between opposing traffic (dividing line)

(b) To present a more forceful deterrent to changing lanes (unbroken lane line)

(c) To improve the conspicuity of the painted lines and provide an enhanced road preview time (all lines)

(d) To control speeding on approaches to a hazard (perceptual countermeasure)

The enhanced pavement markings do not alter or enhance the legal significance of the line. These lines provide more forceful visual clues and /or impart greater separation between opposing traffic.

5.2.2 Enhanced dividing (separation) lines (S3)

5.2.2.1 Description and use

Enhanced dividing (separation) line (S3) is a 200 mm wide broken line as compared to the 100 mm width of the standard S1 line. It should be used where greater separation is required between opposing streams of traffic (See Table 5.1 for separation widths that can be achieved) and where overtaking is permitted in both directions.

Pattern and dimensions of enhanced dividing (separation) lines are shown in Table 5.2. They are supplemented with a staggered raised pavement marker pattern (see Section 15 for marker pattern).

5.2.2.2 Guidelines

Enhanced dividing (separation) lines must only be used, where:

(a) Minimum width for a two-lane carriageway is 7 m plus a minimum width of existing sealed shoulders of 0.5 m each is available, and

(b) AADT volumes are at least 2000 vehicles per day, and

(c) There is demonstrated evidence (supported by crash records) that the standard S1 line is inadequate in separating opposing traffic.

5.2.2.3 Applications

Application of enhanced dividing line (S3) is illustrated below –

Figure 5.1: Enhanced dividing (separation) line (S3)

5.2.3 Enhanced dividing (barrier) lines (BS1, BB1 and BB2)

5.2.3.1 Description and use

BS1, BB1 and BB2 lines should be used where greater separation is required between opposing streams of traffic and overtaking is either restricted or prohibited. Basic features of enhanced dividing (barrier) lines and separation widths that can be achieved are given in Table 5.1. The pattern and dimensions of enhanced dividing (barrier) lines are shown in Table 5.2

Line Type	Pattern	Effective separation that can be achieved (RRPM to RRPM) (Assumes 100mm wide RRPMs)
S3	One broken line 200 mm wide	500 mm
BS1	One unbroken and one broken line 150 mm wide at 150 mm spacing	750 mm
BB1	Two unbroken lines 150 mm wide at 150 mm spacing	750 mm
BB2	Two unbroken lines 200 mm wide at 600 mm spacing	1300 mm

Note: Pattern and dimensions of enhanced dividing (barrier) lines, BS1, BB1 and BB2 are shown in Table 5.2. They are supplemented with Reflective raised pavement markers (RRPMs). Refer to Section 15 for RRPM patterns.

Table 5.1: Basic Features of Enhanced Dividing Lines

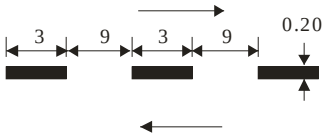
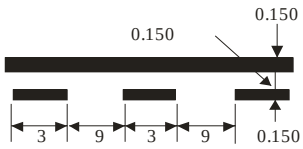
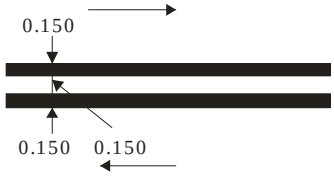
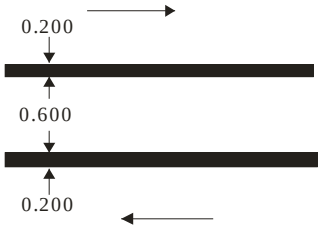
Line Type	Use	Dimensions (m)	Colour
S3	Enhanced dividing (separation) lines strictly in accordance with the guidelines. Approval needed of GM Traffic Management		White
BS1	Enhanced dividing (barrier) lines strictly in accordance with the guidelines. Approval needed of GM Traffic Management		White
BB1	Enhanced dividing (barrier) lines strictly in accordance with the guidelines. Approval needed of GM Traffic Management		White
BB2	Enhanced dividing (barrier) lines strictly in accordance with the guidelines. Approval needed of GM Traffic Management		White

Table 5.2: Enhanced Dividing (separation & barrier) lines

5.2.3.2 Guidelines

Enhanced dividing (barrier) lines must only be used, where:

(a) Minimum width for a two-lane carriageway is 8 m plus a minimum width of existing sealed shoulders of 0.5 m each is available, and

(b) AADT volumes are at least 2000 vehicles per day, and

(c) There is demonstrated evidence (supported by crash records) that the standard lines are inadequate in separating opposing traffic.

(Note: BS1 line is provided where the sight distance is more than 750 m)

5.2.3.3 Applications

Application of enhanced dividing lines, BS1, BB1, BB2 and BB3 is illustrated below.

Figure 5.2: Enhanced dividing (barrier) line (BS1)

Figure 5.3: Enhanced dividing (barrier) line (BB1)

Figure 5.4: Enhanced dividing (barrier) line (BB2)

5.2.4 Enhanced unbroken lane lines (L5)

5.2.4.1 Description and use

Enhanced unbroken lane lines shall be 200 mm wide and shall have a minimum length of 30 m. The pattern and dimensions of enhanced unbroken lane lines (L5) are shown in Table 5.3.

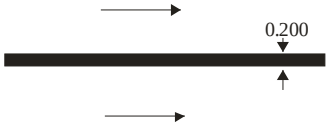
Line Type	Use	Dimensions (m)	Colour
L5	Enhanced lane line strictly in accordance with the guidelines. Approval needed of GM Traffic Management		White

Table 5.3: Enhanced Lane Line (L5)

5.2.4.2 Guidelines

Enhanced unbroken lane lines must only be used, where:

(a) Minimum design lane width is available, and

(b) AADT volumes are at least 2000 vehicles per day, and

(c) There is demonstrated evidence (supported by crash records) that the standard lines are inadequate in separating opposing traffic.

Examples of locations under (c) could be:

(i) Where, high degree of lane definition is critical to prohibit lane changing such as inside a tunnel or

(ii) Between through lane and auxiliary lane on freeways at entry and exit ramps

5.2.4.3 Applications

Application of enhanced unbroken lane line (L5) is illustrated below -

Figure 5.5: Enhanced Lane line (L5)

5.2.5 Enhanced broken profile lane line (L2)

5.2.5.1 Description and use

Enhanced broken profile lane line (L2) is a superior line, compared to conventional L1 line. Ribs across the line provide enhanced visibility and audio-tactile warning to motorists to impart better lane discipline. The pattern and dimensions of enhanced broken profile lane lines (L2) are shown in Table 5.4. Noise impact must be taken into account when considering the use of profile linemarking.

Refer to Section 5.2.6 for specifications, drawings, warrants and applications of these markings.

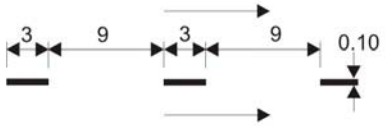
Line Type	Use	Dimensions (m)	Colour
L2	Enhanced lane line (profile on motorways, dual carriageways or on special locations such as bridges (Approval needed of GM, Traffic Management		White

Table 5.4: Enhanced Lane Line (L2)

5.2.5.2 Guidelines

L2 line shall be used on motorways, dual carriageways; or special locations such as bridges and tunnels. Earlier a broken simulated line (using non-reflective raised pavement markers) was used as an L2 lane line. The RTA has discontinued its use.

Noise impact must be taken into account when considering the use of profile linemarking. Refer to Section 5.6 for more details on profile linemarkings.

5.2.5.3 Applications

Application of enhanced lane line (L2) is illustrated below:

Figure 5.6: Profile lane line (L2)

5.2.6 Profile linemarking

5.2.6.1 General

Profile linemarking is a thermoplastic line, consisting of raised ribs at regular intervals. These markings provide a more durable marking, enhanced visibility and an audio-tactile warning to the motorists.

Figure 5.7: Raised ribs across profile linemarking

This section provides guidance on the use of profile linemarking for marking longitudinal lines while preserving the safe use of roads by all road users including cyclists, pedestrians and motorcyclists.

5.2.6.2 Benefits

The profile linemarking provides:

(a) An audio-tactile effect to motorists, should they stray from the carriageway and run onto the marking due to fatigue

(b) Enhanced visibility during adverse weather conditions, especially at night

5.2.6.3 Types

Currently two different patterns are available, designed to have a raised profile. They are:

(a) Type A

Formed by mechanically screeding a conventional thermoplastic line and simultaneously applying transverse ribs of the same thermoplastic material at a regular interval. This type produces a good audible and tactile effect.

Figure 5.8: Type A Profile linemarking

(b) Type B

Formed by extruding only, transverse ribs, placed directly onto the road surface. This line produces little audible effect and is intermediate in tactile effect. This type does provide drainage benefits. Any attempt to apply a coat of paint to form a continuous line, should be discouraged, if aquaplaning is a major concern.

The spacing and configuration of ribs can be varied to suit any requirements, however, 250 mm is considered to be the optimum spacing.

Figure 5.9: Type B Profile linemarking

5.2.6.4 Specifications

The ribs shall be 60 mm ± 10 mm long (measured along the line) with a rib spacing of 250 mm ± 50 mm. The height of ribs shall be 10 mm ± 2 mm.

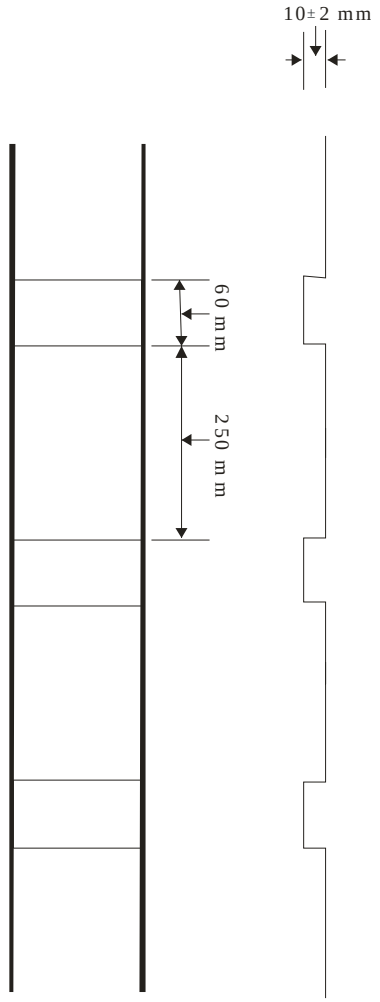


Figure 5.10: Profile line on Motorways and Dual Carriageways

5.2.6.5 Guidelines

(a) As Lane lines (Only type A)

A broken profile lane line (L2) is used on motorways, dual carriageways; or special locations such as bridges and tunnels. Refer to Section 5.2.5 for description, guidelines and application of L2 lines.

Profile lane line may also be used as enhanced lane line (L5). Refer to Section 5.2.4 for description, guidelines and application of L5 lines.

(b) As edge lines

(i) Predominantly profile linemarking is recommended for use as an edge line on motorways or dual carriageways to separate the edge of the sealed shoulder from the main carriageway. It is particularly useful on sections of road where drivers are subject to fatigue or sections which experience frequent foggy conditions. Refer to Section 4.7 for description, guidelines and application of edge lines

(ii) It should be ensured that:

- Minimum width for a two-lane carriageway is 7 m.
- The shoulder width clear of the edge line is greater than 1.2 m or 1.5 m adjacent to a guard fence, kerb or other obstacle. This width requirement does not apply to right hand shoulders on one-way carriageways.
- AADT volumes are at least 10,000 vehicles per day.
- There is demonstrated evidence (supported by run-off the road crash records) that the standard lines are inadequate in discouraging off carriageway vehicles.

(iii) Other road lengths where there is an abnormally high number of horizontal curves, especially on mountain passes, profile linemarking may be used as an edge line.

(iv) Profile lines may also be used as an audio-tactile device to guide motorists where drivers may experience difficulty in following longitudinal linemarking for example at S-lanes and intersections.

(c) As enhanced dividing lines

(i) Profile linemarking may also be used as enhanced dividing lines to separate opposing streams of traffic. Refer to Section 5.2.2 and 5.2.3 for description, guidelines and application of enhanced dividing lines.

(ii) It is particularly useful on sections of road with high a frequency of head on collisions or where drivers are subject to fatigue or sections, which experience frequent foggy conditions.

(iii) It should be ensured that:

- Minimum width for a two-lane (two-way) carriageway is 7 m.
- The shoulder width clear of the edge line is greater than 1.2 m or 1.5 m adjacent to a guard fence, kerb or other obstacle.
- AADT volumes are at least 10,000 vehicles per day.
- There is demonstrated evidence (supported by head-on road crash records) that the standard lines are inadequate in separating opposing traffic.

(d) Other applications

(i) Other road lengths where there is an abnormally high number of horizontal curves, especially on mountain passes, profile linemarking may be used as an edge line or dividing lines.

(ii) Profile lines may also be used as an audio-tactile device to guide motorists where drivers may experience difficulty in following longitudinal linemarking for example at S-lanes and intersections.

(e) Restrictions on use

(i) Use of profile lines requires approval from the General Manager, Traffic Management.

(ii) As traversing profile linemarking emits an audio-tactile sound, care should be taken not to install these lines in a noise sensitive area. Profile lines should not be installed within 500 metres of a residential building unless appropriate noise barriers are installed, or unless the frequency and severity of fatigue related crashes in the area are such that a continuous treatment is considered essential on safety grounds. In such cases, a distance of 200 metres may be acceptable subject to consultation with the property owners.

(iii) It should be noted that motorcyclists may not readily distinguish the profile line from a painted line, and therefore may find this type of delineation hazardous.

(iv) Profile lines should not be used, if the pavement is scheduled for re-surfacing or reconstruction within 3 years.

(v) Profile linemarking should be discontinued at defined pedestrian and bicycle crossings, and replaced by non-profile marking. It would normally be appropriate to commence the non-profile marking a minimum of 1m (one) before the crossing and finish a minimum of 1m (one) after the crossing.

(vi) Profile linemarkings should be replaced with normal continuous markings in the vicinity of other locations where cyclists are likely to cross the lines when riding generally parallel to them. Such locations would be the termination of hard shoulders, and in the vicinity of side road junctions. In these cases the profile line marking should be replaced by a continuous marking at least 20 m in advance of the end of any hard shoulder/side road junction. For merging and diverging lanes the profile line marking should be replaced 10 m in advance of the merge or diverge lane.

(vii) Where gully pits or similar features occur on the hard shoulders, cyclists may need to cross the adjacent edge line marking to avoid them. Any profile line marking adjacent to such features should be replaced by a normal continuous marking for a distance of 10 m on both sides of the gully pit.

(viii) Motorcyclists may encounter some discomfort if the profile line marking was laid on curves of radii less than 1000 m, and motorcyclists were likely to cross them. It is unlikely that difficulties will occur where profile linemarkings are provided in conjunction with hard shoulder of 1 m or less. For a sealed shoulder of 1.5 m or more, profile line-markings should be replaced by continuous markings if there is any concern that motorcyclists might frequently cross into the sealed shoulder.

(ix) Drainage gaps should be provided, particularly where the longitudinal fall is less than 1:150, and there is a cross-fall towards the profile line. The gap should be 100 mm to 150 mm wide at 36 m intervals.

(x) Where profile linemarking is renewed, care should be taken that the rib height is not increased above the 6 mm height prescribed. Experience suggests that the only satisfactory way of renewing is to remove the original line completely before re-laying. It may also be necessary for drainage purposes to remove any existing line in the vicinity of a cross fall change area where the longitudinal fall is less than 1:150, if the final thickness of the base line is likely to exceed 3 to 4 mm.

5.3 Enhanced lane separation devices

5.3.1 General

Enhanced lane separation devices are a more forceful form of visual delineation and can also be used to discourage lateral movements (lane crossing) at potentially hazardous locations. These devices should only be used in areas where it can be demonstrated through crash records or erratic traffic manoeuvres that the existing pavement markings and raised pavement markers are not adequate.

5.3.2 Devices

Pavement flaps, collapsible delineator (e.g. Klemmfix), flexible bollards and candy bars are used to establish a physical separation between the lanes of travel. Some of these devices may also be used for tidal flow management (see Section 5.4).

New products may be used by the RTA, provided that the RTA Project Manager obtains the approval of the General Manager, Traffic Management.

5.3.3 Use

Enhanced lane separation devices may be used to provide additional warning of a painted island on a crest or to control merge movements at a seagull or similar island arrangement. They may also be used on the approaches to Toll booths.

Typical uses of arrangements of enhanced lane separation devices are to:

(a) Improve lane control

(b) Supplement dividing (barrier) lines or painted islands where frequent and hazardous infringements occur

(c) Form an approach treatment to a median or other central obstruction

5.3.3.1 Guidelines

Enhanced lane separation devices are only prescribed for use to discourage lateral movements (lane crossing) and should only be used in areas where, it can be demonstrated through crash records or erratic traffic manoeuvres that the existing pavement markings and raised pavement markers are not adequate.

Their use shall be limited to the following:

(a) Where the 85th percentile approach speed is less than 85km/h

(b) The maximum height shall be 1000 mm

(c) Enhanced lane separation devices shall not be installed on two-way carriageways less than 6.8 m in width and the lane width is less than 3 m

(d) Enhanced lane separation devices should not be installed near well-defined areas of pedestrian activity or where it is likely to be hazardous to motorcycle and bicycle riders

(e) Enhanced lane separation devices shall have a retro-reflective sheeting or delineator. The colour of the retro-reflective material shall be:

- Yellow when used to supplement dividing line. On collapsible delineator, yellow sheeting with diagonal hash pattern should be used.
- White, when used to supplement lane line. On collapsible delineator, white sheeting with chevron pattern should be used.

(f) Preferred spacing for pavement flaps is 3 m and preferred spacing for collapsible delineator, flexible bollards and candy bars is 12 m, so as to minimise the possibility of loss of vehicular control if traversed.

5.3.3.2 Application

Some examples of enhanced lane separation devices are illustrated below.

Figure 5.11: Enhanced lane separation devices (Pavement flaps)

Figure 5.12: Enhanced lane separation devices (Collapsible delineator)

Figure 5.13: Enhanced lane separation devices (Flexible bollards)

5.4 Delineation devices for tidal flow management

5.4.1 General

Due to the increasing number of vehicles on the network and the subsequent increase in congestion, there has been a growing need to improve the efficiency of the existing road system. One method of enhancing the capacity of the network has been via the use of tidal flow schemes. Tidal flow schemes allocate more lanes in the direction of the heaviest traffic flow at certain times of the day.

5.4.2 Devices

5.4.2.1 Manual schemes

5.4.2.1.1 Candy bars

The most common practice is to use candy bars to implement and affect these manual schemes. These bars are typically made from a hard plastic material and are used as a delineator. The bars are easily moved to and from sockets drilled and epoxied into the pavement to establish different lane configurations. As well as their use in tidal flow applications, candy bars are used as enhanced lane separation devices at various isolated locations (refer to Section 5.3).

Preferred spacing of candy bars is 12 m; however, it may be reduced depending upon the circumstances, e.g. on curves, lateral transitions and adjacent to side streets subject to turn prohibitions.

5.4.2.1.2 Other devices

Where sockets can not be drilled (e.g. on bridge decks) and where overhead Lane Use Signs (LUS – see Section 5.5) are not applicable, pavement flaps or a collapsible delineator may be used.

Manual schemes are labour intensive thus have a higher operating cost.

5.4.2.2 Automated schemes

5.4.2.2.1 Movable medians

Partially automated tidal flow systems use a specially designed trailer to shift solid rubber medians (with reboundable plastic flaps) from one lane to another (See Figure 5.13). The units are joined together to provide a continuous separation between opposing directions of traffic.

Some manual intervention is still required.

Figure 5.14: A typical movable median unit

5.4.2.2.2 Other devices

Fully automated electronic systems which comprise in-pavement lights and/or overhead gantries are also available (see Figure 5.15). More complex remotely controlled moveable medians are also available (see Figure 5.16).

Figure 5.15: Application of Typical Tidal Flow Devices (overhead gantries)

Figure 5.16: Application of Typical Tidal Flow Devices (remotely controlled moveable median)

5.4.3 Use

Delineation devices for tidal flow management enhance the definition of dividing line, separating traffic in opposing direction and to discourage lateral movements (lane crossing).

5.4.3.1 Guidelines

Delineation devices for tidal flow management shall be used:

(a) Where the 85th percentile approach speed is less than 85km/h

(b) The maximum height of the device shall be 1000 mm

(c) Delineation devices for tidal flow management shall not be installed on two-way carriageways less than 6.8 m in width and the lane width is less than 3 m

(d) Delineation devices for tidal flow management should not be installed near well-defined areas of pedestrian activity or where it is likely to be hazardous to motorcycle and bicycle riders

(e) When using alternate schemes, the basic delineation principles are still to apply. For example the pavement lights are to be yellow when installed to separate traffic travelling in opposite directions and the colour of the retro-reflective sheeting shall be yellow.

(f) The preferred spacing for collapsible delineators, bollards and candy bars is 12 m, so as to minimise the possibility of loss of vehicular control if traversed.

5.5 Lane Usage Signs

5.5.1 General

In addition to or in place of pavement markings, candy bars etc; to separate opposing traffic and designating lanes for traffic moving in the same direction in tidal flow and other complex situations, overhead Lane Usage Signs (LUS) can be used. Locations may be multi-lane bridges and tunnels. LUS are to be green downward pointing arrows and red crosses. Flashing red crosses may be used when the direction of traffic in the lane is to be changed.

5.5.2 Use

The basic aims of these signs are to provide enhanced direction to road users regarding lane use, convey a clear meaning and give adequate time for proper response.

5.5.2.1 Guidelines

The length of the bridge or tunnel and the approach speeds would be important factors in deciding how many and how large and at what spacing these signs should be placed. As a rough guideline, spacing of approximately 180 m is suitable in 80Km/h speed environment. The first sign should be visible from a distance equivalent to decision sight distance which is 195 m for 60km/h and 280 m for 80km/h approach speed.

They have two states;

(a) Green means lane open (this is the default state).

(b) Red means lane closed – Should be used for an incident that causes the lane to be unsafe for use or when the lane is being used by vehicles travelling in the opposite direction. Flashing red crosses are used to inform motorists of a hazardous situation where the safety of motorists or maintenance workers is at risk or when the direction of traffic in the lane is to be changed.

5.5.2.2 Application

Some examples of Lane Usage Signs (LUS) are illustrated below.

Figure 5.17: Application of Lane Usage Signs (LUS)

5.6 Transverse line marking as a perceptual counter measure to speeding

5.6.1 General

Traditional regulatory measures used to control speed are typically setting speed limits and enforcing them. Traffic calming efforts such as speed humps, roundabouts, and pavement textures are also used to encourage road users to reduce their speeds, especially in residential areas.

An alternative way to reduce excessive speeds is to target speed perception, one basic aspect of the driving task. Perceptual countermeasures serve to alter drivers' perceptions of the correct speed for a particular road so drivers may assume a lower speed is more appropriate. While regulatory measures require enforcement, traffic calming and passive speed control measures are intended to be self-enforcing.

Use of perceptual counter measures requires approval of the General Manager Safer Roads.

5.6.2 Rumble strips

Transverse road markings, placed across the road rather than down the side, can be used to alter speeds by modifying drivers' perception. The transverse marking most commonly used is a 'polymer modified binder

(PMB) spray seal' strip (refer to Section 5.6.4.2 for details). This marking pattern may be an effective measure for reducing speeds when placed at decreasing distances so the spacing between markings is continuously reduced in the direction of movement. This layout of markings creates the illusion of acceleration that would cause the driver to slow down. The idea is to space the lines in such a way that the driver who failed to slow would see the transverse lines at an increasing rate and when the driver decelerates appropriately, the lines would move past at a constant rate.

5.6.3 Use

Rumble strips are not recommended for extensive use. They should only be used as an alerting device to address a road safety problem where other conventional measures such a signing and road markings have proven to be ineffective, and change to geometric layout is not possible.

Rumble strips alone should not be used as a traffic management device for the control of speeds. It is recommended that installation of the rumble strips should be accompanied by appropriate signing to convey the nature of the potential hazard, and hence communicate the reason for the installation to drivers.

5.6.3.1 Guidelines

Before deciding to use rumble strips, it is recommended that the following signing options should be considered:

(a) Increased level of signing on the approaches by duplicating the recommended signs on both sides of the road.

(b) Provision of edge lines.

(c) Installation of retroreflective raised pavement markers to supplement separation lines and edge lines.

(d) Increased size of the recommended signs (and hazard markers where applicable).

(e) Use of "REDUCE SPEED" signs. These should only be used where there is considerable danger to the motorist if this sign is disobeyed.

The above measures may be combined to achieve the desired level of warning. If the highest practicable level of signing still fails to produce a

satisfactory result, the installation of rumble strips may be considered in conjunction with a high level of signing.

A high level of signing alone is generally more effective and less expensive than low level signing with rumble strips.

5.6.4.1 Spacing

The spacing generally used is that of a converging pattern of transverse strips placed such that a decelerating vehicle will strike the strips at a constant time interval of not less than 0.5 second. It is recommended that pattern of up to 10 strips should be used such that a strip is struck each second whilst decelerating at a comfortable rate. Figure 5.18 shows the pattern for 100 km/h, 80km/h and 60 km/h approach speeds.

It should be noted that these are example patterns only. Other patterns may be considered for approval.

5.6.4.2 Strip Dimensions

It is considered that the strip widths should not be less than the average car axle spacing. The recommended widths are shown in Figure 5.18.

The height of strips is generally 10-20 mm and they are usually constructed by a polymer modified binder (PMB) spray seal on the existing pavement. It is recommended that the last 15-30 m prior to the stop or give way line should be continuously treated with the same rough textured material used for the rumble strips (asphalt or recycled rubber) to provide a rough surface on which to decelerate quickly should braking occur too late.

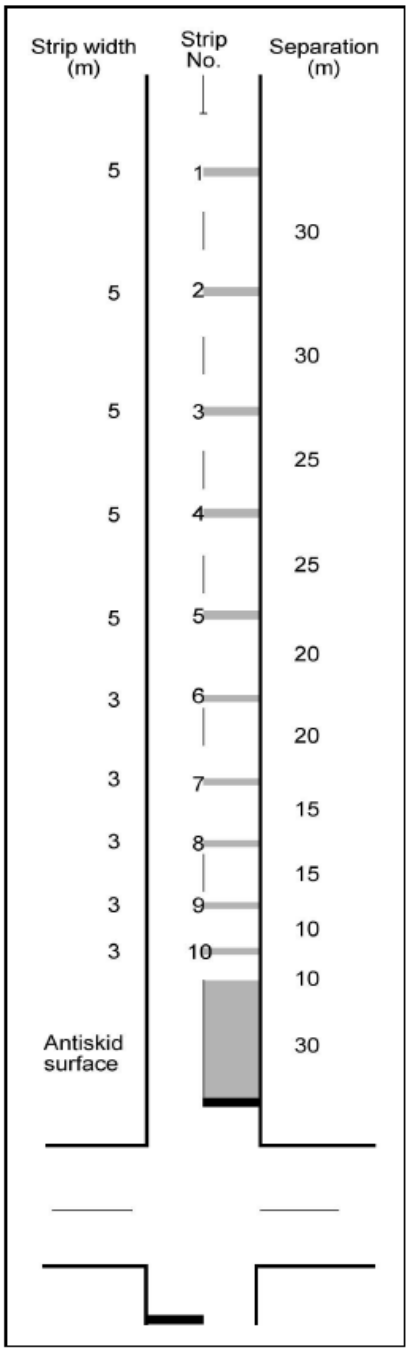


Figure 5.18: Recommended rumble strip pattern on intersection approach for ≥100 km/h approach speed

Notes –

(i) Figure shown is for ≥100 km/h approach speed environment

(ii) For <100 km/h to ≥80 km/h do not provide strip numbers 1 and 2; anti-skid surface length 20 to 30 m

(iii) For <80 km/h to ≥60 km/h do not provide strip numbers 1 to 4; antiskid surface length 15 to 20 m.

5.7 Enhanced Safety Barrier Delineation

5.7.1 General

Safety Barriers are designed to protect vehicles from roadside hazards and to safely redirect the errant vehicle. Under some circumstances the lack of conspicuity or the road geometry can transform a barrier it into a roadside hazard and under these circumstances warrant the use of enhanced delineation.

5.7.2 Use

The basic aims of these treatments are to improve the conspicuity of the Safety Barrier by providing enhanced delineation and hence crash avoidance. This enhanced treatment should only be used in areas where it can be demonstrated through crash records or erratic traffic manoeuvres that the existing Safety Barrier delineation is not adequate.

Use of Enhanced Safety Barrier Delineation requires approval of the General Manager Traffic and Safety Management.

5.7.3 Material Requirements.

The enhanced Safety Barrier delineation shall be yellow 150mm wide waterborne high durability marking paint (with 1.9 Index Glass Beads). It shall be designed to resist sagging and with superior adhesion to the surface of concrete and galvanised safety barriers.

5.7.4 Guidelines

Enhanced Safety Barrier delineation shall be continuous. Length of treatment required shall be decided on-site.

5.7.5 Devices

5.7.5.1 W Beam application

Enhanced Safety Barrier Delineation shall be 150mm wide applied centrally within the concave area of W beam.

Figure 5.19: Application of enhanced Safety Barrier treatment – W Beam

5.7.5.2 Concrete Barrier application – non-central barrier

Enhanced Safety Barrier Delineation shall be 150mm wide applied 200mm ± 50mm from the top of the barrier.

Figure 5.20: Application of enhanced Safety Barrier treatment – Non-Central Concrete Barrier

5.7.5.3 Concrete Barrier application - central barrier

Enhanced Central Concrete Safety Barrier Delineation shall be:

- For curve advisory speeds less than 50km/h, yellow painted retroreflective chevrons as per Figure 5.22, 300mm wide, 1500mm long, 1500mm ± 50mm gap, applied 100mm ± 50mm from the top of the barrier. Length shall be from curve tangent point to curve

tangent point and two extra chevrons shall be placed before and after the curve tangent points

- For curve advisory speeds greater than 50km/h, yellow painted retroreflective chevrons as per Figure 5.22, 300mm wide, 1500mm long, 3000mm± 50mm gap, applied 100mm ± 50mm from the top of the barrier. Length shall be from curve tangent point to curve tangent point and two extra chevrons shall be placed before and after the curve tangent points

Use of Curve Alignment Markers (CAM's) may no longer be required after treatment of central barrier. Decision shall be made on-site.

Figure 5.21: Application of enhanced Safety Barrier treatment – Central Concrete Barrier

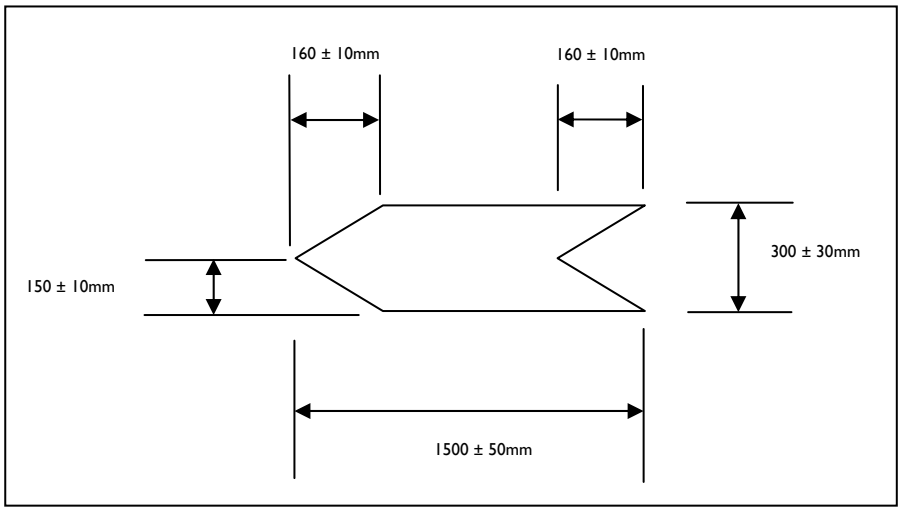


Figure 5.22: Dimensions of Yellow Painted Retroreflective Chevron Central Concrete Barrier.

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