Supplement to Austroads Guide to Traffic Management

Part 10: Traffic Control and Communication Devices (2009)

OCTOBER 2015

vicroads.vic.gov.au
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1. Introduction

1.1 General

All road agencies across Australia are working towards greater consistency between States/Territories in how road networks are managed. In order to achieve this, the Austroads Guide to Traffic Management and Australian Standards relating to traffic management have been adopted to assist in providing that level of consistency and harmonisation across all jurisdictions. This agreement means that these Austroads Guides and the Australia Standards are the primary technical references.

Austroads Guide to Traffic Management Part 10: Traffic Control and Communication Devices (AGTM Part 10) is a nationally agreed guideline document outlining the use of traffic control devices on the road network and has been adopted by all jurisdictions, including VicRoads.

All jurisdictions will be developing their own supplement to clearly identify where its practices currently differ and to provide additional guidance to that contained within AGTM Part 10. This document is the VicRoads supplement and shall be read in conjunction with AGTM Part 10.

1.2 How to Use this Supplement

There are two key parts to this document:

Classification of Supplement Information: this table classifies supplement information as a Departure, Additional Information or both. This information assists with identifying its hierarchy in relation to the Austroads Guide to Traffic Management.

Details of Supplement Information: this section provides the details of the supplement information.

- Departures: where VicRoads practices differ from the guidance in the Austroads Guide to Traffic Management. Where this occurs, these differences or ‘Departures’ will be highlighted in a box. The information inside the box takes precedence over the Austroads Guide to Traffic Management section. The Austroads Guide to Traffic Management section is not applicable in these instances.

- Additional Information: all information not identified as a departure provides further guidance to the Austroads Guide to Traffic Management and is read and applied in conjunction with the Austroads Guide to Traffic Management section.

Where a section does not appear in the body of this supplement, the Austroads Guide to Traffic Management requirements are followed.
## 2. Classification of Supplement Information

The classification of each section as a Departure, Additional Information or both is shown in the table below.

<table>
<thead>
<tr>
<th>Section</th>
<th>Classification</th>
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</thead>
<tbody>
<tr>
<td>1.2</td>
<td>Additional Information</td>
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<tr>
<td>Section</td>
<td>Requirement</td>
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<td>9.1</td>
<td>Additional Information</td>
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</table>

Austroads Guide to Traffic Management requirements are followed for sections not shown in this table.
3. Details of Changes

Section 1.2 – Traffic Control Devices – Definitions and Functions

For further information regarding the use of Traffic Control Devices in Victoria, including the responsibility and authority to install or remove these devices, refer to Traffic Engineering Manual Volume 3, Part 2.1.

Section 2.3.2 – Considerations for Aged Road Users and People with Disabilities

Commonwealth Disability Discrimination Act

Under section 24(1) of the Disability Discrimination Act, it is unlawful to discriminate against people with disabilities when making facilities available.

Under section 24(2) of the Disability Discrimination Act, it is not unlawful to discriminate against a person with disabilities if in making the facilities available, unjustifiable hardship is caused to the person providing the facilities (refer to the VicRoads Supplement to AS 1428.4.1:2009 Clause 1.2.1 for further guidance).

Responsibilities for provision of facilities for people with a disability

For information regarding the responsibilities for provision of facilities for people with a disability, refer to Clause 1.2.1 of AS 1428.4.1:2009.

VicRoads Strategy and Action Plan

The following steps will be undertaken by VicRoads to meet the objectives of the Disability Discrimination Act:

- All new road infrastructure and traffic works provided by VicRoads will include facilities to assist pedestrians with a disability. These will be funded under a relevant core business program.
- VicRoads is responsible for facilities on freeways and arterial roads.
- Works will be implemented progressively over 20 years.
- All facilities which are within the physical scope of the new/improvement works shall be included in the cost and funding of the new/improvement works.
- Other facilities adjacent to the improvement project, but not physically affected, should be considered for implementation in conjunction with the improvement project if:
  - The facilities were scheduled to be undertaken in the retrofit program within 5 years.
  - Economies of costs can be achieved by construction with the improvement project.

Facilities for people with a disability on arterial road projects

In some instances, depending on demonstrated needs or design features required, other facilities for disabled road users may also be required such as:

- pedestrian crossings across left turn slip lanes
- cut throughs at medians
- kerb ramps at pedestrian road crossing points
- puffin pedestrian signals.

a) VicRoads improvement projects

All road infrastructure projects being implemented shall provide facilities to assist people with a disability. The cost of the facilities shall be funded as part of the project.

b) VicRoads retrofitting projects

Works may be included for retrofitting of existing facilities to provide facilities for people with a disability.

Works on arterial roads by others (e.g. developers, councils, utility providers).

Where works are being carried out on arterial roads by developers, municipal councils or utility providers, there may be a need to replace affected pedestrian facilities so that they are suitable for people with a disability.
c) Bus stops

All new bus stops (excluding dedicated school bus stops) and bus interchanges provided on arterial roads are to include facilities for people with a disability.

Facilities must cater for the vision impaired and people using wheelchairs. Any new footpath links at bus stops are to be provided by municipal councils.

As councils are responsible for the maintenance of footpaths and the tactile ground surface indicators, the VicRoads Region or Major Project office undertaking improvement works should obtain agreement from the relevant municipal council regarding works affecting a footpath. The relevant public bus operator, as well as Public Transport Victoria may also need to be involved.

Typical treatments for kerb-side stops with and without bus shelters for fully accessible bus stops are shown in AS 1428.4.1:2009.

d) Tram stops

All new tram or light-rail stops/safety zones shall include facilities for people with a disability.

Programming of annual retrofit works

a) Funding and priorities

VicRoads funds agreed works on freeways and arterial roads.

Prioritised listings for each compliance treatment are prepared by each VicRoads Region in accordance with annual program guidelines for a relevant pedestrian program.

Prioritising should be carried out for each compliance treatment category based on regional knowledge and discussions with council disability committees, disability advocacy groups and disability representative groups concerned with public transport access, people with special needs, bus and tram operators and PTV.

Initial attention should be directed to higher population areas, shopping centres, retirement villages, hospitals, aged care centres and centres providing services for people with special needs. These areas are likely to be frequented by people with disabilities.

Furthermore, people with special needs are likely to have established travel patterns (e.g. pedestrians and public transport patrons) and treatments may need to be carried out along established travel routes, existing bus routes and modal interchanges.

The usage of road infrastructure and traffic facilities by people with special needs may need to be determined from surveys, or from discussions with bus and tram operators, and others. It is also necessary to consider consistency of treatments along a particular route.

To determine the time frame for the installation of retrofit works, factors that will increase hazards such as high traffic flows, the current level of usage by people with disabilities, provision of public transport, and the presence of footpaths leading from and to the facility, should be considered.

b) Scope of works

When treating a site, the whole of an intersection or midblock crossing should be treated with audio tactile push buttons, kerb ramps, TGSIs and other facilities as required, including retrofitting the footpath areas that are not generally VicRoads’ responsibility. The footpath areas are included to provide a complete treatment for disabled pedestrians crossing at the arterial road intersection.

Upon completion of DDA works, VicRoads has an ongoing maintenance responsibility for kerb ramps and TGSIs in medians and islands (refer to the Code of Practice for Operational Responsibility for Public Roads).

Kerb ramps and TGSIs in the footpath areas at intersections or midblock crossings are to be maintained by the municipal council. Therefore council agreement must be obtained for the proposed treatment works and for ongoing maintenance, prior to implementation.

Where a continuous footpath is a prerequisite to the implementation of retrofit works on arterial roads, it is desirable that councils consider the funding and installation of footpaths at the same time as the VicRoads retrofit works so that the facility is complete and made fully accessible.
Recording complaints
Where a request for a treatment to provide facilities for pedestrians with disabilities is received and the costs of implementing the standards exceed the benefits of a particular treatment, the case needs to be carefully considered. VicRoads’ regions should contact the Policy and Programs (P&P) division in the first instance to advise of any complaint in this regard.

Further to advice from the P&P division, VicRoads regions may contact the Human Rights and Equal Opportunity Commission (HREOC) for assistance in dealing with the matter (http://www.humanrights.gov.au).

Section 3.2 – Principles for Preparation of Schemes
Presentation of schemes on drawings
Drawings for signing and marking schemes should be produced to a high standard so that signs and road markings are correctly interpreted and installed by construction personnel. A typical signing and marking scheme plan is shown in Figure 1. Schemes may also include signs and markings for sections of road not associated with intersections, particularly for major road projects.

For major road projects, traffic signal layout plans include the regulatory signs associated with the intersection, and care should be taken to ensure that these plans are consistent with the plans for the overall signing and marking scheme.

Figure 1: Typical signing and marking scheme plan
Preparation of drawings

The preparation of drawings should be in accordance with the following requirements:

a) Base plans

Base plans should comprise construction plans showing outlines of all carriageways, structures, traffic islands, medians etc., plus chainages and, if possible, contours. Such plans should be obtained from the road designer. All information which would unnecessarily clutter the plan, and is not essential such as curve or coordinate data, should not appear on the base plan.

b) Scales

The following scales are recommended for the drawings:

- 1:500 – general use for most projects
- 1:1000 – for large projects, where a substantial length or area is involved. Note that specific aspects may have to be produced at a scale of 1:500 where greater detail is to be shown
- 1:200 or 1:250 – any scheme or part of a scheme where there is complexity of detail which should be carefully located or coordinated at a larger scale, e.g. signalised intersections.

c) Working plans

The scheme should be prepared on a separate plan or series of plans having its own title block details and unique plan numbers.

d) Pavement marking detail

Details of pavement markings, including all lane and separation line stripes and gaps, should be provided accurately to scale with all necessary dimensions or references. This will allow markings to be accurately located on the ground by reading or scaling from the plan.

e) Sign detail

The position of each sign should be shown as accurately as the scale of the plan will allow. On larger scale plans where coordination of the relative positions of several signs (e.g. those in close proximity to each other or to possible sight obstructions) is needed, the width of each sign should be plotted to scale. In such cases a note should be provided to indicate the importance of accurately locating the signs and the reason why it is so important.

At the final drafting stage, a properly drafted drawing of each sign face is placed on the plan and should be clearly associated with the sign's position on the plan. The sign number, size of sign, and a reference number for each sign are placed beside the drawing image. Drawings of standard and commonly used signs may be incorporated into libraries of signs within computer drafting and design packages. The sign numbers shown on the plan are either the standard numbers for standard signs or a drawing or sketch number where a special drawing or sketch of the sign is required. Where standard signs are shown, the required sign size (i.e. size A, B, C etc.) shall be included.

f) Special drawings of sign faces

These are essential for all direction signs, tourist signs, community facility signs and any other sign on which information unique to the particular sign is displayed. Refer to AS 1743 for design standards.

g) Sign structures

Outline cross sections of any major sign structures or over-bridge attachments, as illustrated in Figure 2, should accompany each scheme. Sufficient detail is required to enable the structural design and manufacture of the sign support structure.
Figure 2: Typical outline plan for a major sign structure

Sign and post schedules

Upon finalisation of the scheme, a sign and post schedule is prepared. A typical example is shown in Table 1.
Table 1: Typical sign and post schedule

<table>
<thead>
<tr>
<th>CADD Drawing No.</th>
<th>No.</th>
<th>Sign Type</th>
<th>Sign Size W x H</th>
<th>No. Signs per Assembly</th>
<th>No. &amp; Type of Posts per Assembly</th>
<th>Mounting Height H mm</th>
<th>Post Hole Depth P mm</th>
<th>Length of Post L mm</th>
<th>Spacing between Posts S mm</th>
<th>Clearance E of T/L or F of K S mm</th>
<th>Total No. of Assemblies</th>
<th>Fitting Type</th>
<th>No. of Fittings per Assembly</th>
<th>Remarks</th>
</tr>
</thead>
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<tr>
<td>85</td>
<td></td>
<td>D4-2-3</td>
<td>1800 x 300</td>
<td>1</td>
<td>3 OFF 50 NB</td>
<td>500</td>
<td>600</td>
<td>1650</td>
<td>810</td>
<td>500</td>
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<td>M10 BOLTS</td>
<td>9</td>
<td>Hazard Board</td>
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<tr>
<td>89</td>
<td></td>
<td>R6-V13-2</td>
<td>1200 x 1170</td>
<td>2</td>
<td>2 OFF 50 NB</td>
<td>2100</td>
<td>600</td>
<td>4600*</td>
<td>720</td>
<td>2000</td>
<td>1</td>
<td>Prohibition Sign</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>R6-20A</td>
<td>1200 x 600</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td>Freeway ENTRANCE</td>
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<td>97</td>
<td></td>
<td>R4-1B</td>
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<td>1</td>
<td>1 OFF 50 NB</td>
<td>1500</td>
<td>600</td>
<td>2600</td>
<td>2000</td>
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<td>2</td>
<td>100k</td>
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</tr>
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<td>100</td>
<td></td>
<td>R1-2B</td>
<td>1039 X 900</td>
<td>1</td>
<td>1 OFF 50 NB</td>
<td>1500</td>
<td>600</td>
<td>3250</td>
<td>500</td>
<td></td>
<td>2</td>
<td>GIVE WAY</td>
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<td>105</td>
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<td>R2-6B (R)</td>
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<td>1500</td>
<td>600</td>
<td>3250</td>
<td>500</td>
<td></td>
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<td>106</td>
<td></td>
<td>R2-6B (L)</td>
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<td>107</td>
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<td>R2-3C (L)</td>
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<td>500</td>
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<td>443486</td>
<td>109</td>
<td>G2-VIC</td>
<td>3200 X 1050</td>
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<td>2 OFF 180 x 100 TIMBER</td>
<td>2200</td>
<td>1200</td>
<td>2000</td>
<td>2000</td>
<td></td>
<td>2</td>
<td>M79 Melbourne</td>
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<tr>
<td>443485</td>
<td>110</td>
<td>G1-V2B</td>
<td>2600 X 2265</td>
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<td>3 OFF 180 x 100 TIMBER</td>
<td>2200</td>
<td>1200</td>
<td>1200</td>
<td>2000</td>
<td></td>
<td>1</td>
<td>C324 Woodend</td>
<td>18</td>
<td>Bendigo via M79 Fwy</td>
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<tr>
<td>443484</td>
<td>111</td>
<td>G8-V11-2B</td>
<td>900 X 460</td>
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<td>600</td>
<td>2800</td>
<td>2000</td>
<td></td>
<td>1</td>
<td>C 324</td>
<td>2</td>
<td>M79 Melbourne</td>
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</table>
### Notes to Table 1:

1. A drawing number or manufacturing sketch number is to be provided for any sign not able to be identified by a standard sign number. Standard sign numbers can be obtained from AS 1742.1 or AS 1743, and are to include size designation (e.g. A, B, C etc.)

2. See Figure 3 and Appendix D4 of AS 1742.2:2009.


4. Dimension F (see Figure 3) should be determined separately for each post in a multiple post installation. It will usually need to be determined on site if the sign is on a side slope.

5. See Appendix D2.3 of AS 1742.2:2009.

6. Fitting type designation to be determined from manufacturers brochures.


<table>
<thead>
<tr>
<th>CADD Drawing No.</th>
<th>No.</th>
<th>Sign Type</th>
<th>Sign Size W x H</th>
<th>No. Signs per Assembly</th>
<th>No. &amp; Type of Posts per Assembly</th>
<th>Mounting Height H mm</th>
<th>Post Hole Depth P mm</th>
<th>Length of Post L mm</th>
<th>Spacing between Posts S mm</th>
<th>Clearance E of T/L or F of K S mm</th>
<th>Total No. of Assemblies</th>
<th>Fitting Type</th>
<th>No. of Fittings per Assembly</th>
<th>Remarks</th>
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<td>443481</td>
<td>112</td>
<td>G2-V1B</td>
<td>2400 X 780</td>
<td>3</td>
<td>2 OFF 180 x 100 TIMBER</td>
<td>3620</td>
<td>1200</td>
<td>1500</td>
<td>2000</td>
<td>1</td>
<td>3</td>
<td>C.324 Woodend</td>
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<tr>
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<td></td>
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<td>C.324 Romsey</td>
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<td></td>
<td>2200</td>
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<td>Hanging Rock Wineries</td>
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<td></td>
</tr>
</tbody>
</table>
Figure 3 below shows a typical arrangement for a side mounted sign to be read in conjunction with post schedule Table 1 and illustrates the calculation of post length.

![Diagram of post length calculation](image)

* Where the sign is on a cut batter and frangible posts are required, this dimension should be 2200mm min., except that if the batter slope is 2:1 or steeper it may be reduced provided that the corner of the sign is at least 800 mm above ground level.

Post Length \( L = (D - 50) + F + P \)

**Figure 3: Calculation of post lengths**

Notes to Figure 3:
- **W** = width of sign.
- **D** = depth of sign.
- **H** = height above edge of pavement (unberbed) or lip of kerb.
- **P** = post hole depth.
- **F** = length of post between ground surface and lower edge of sign (see Note 4 to Table 1 above).
- **L** = total length of post required.
- **S** = spacing between posts.
- **C** = clearance from face of kerb or edge of shoulder.

**Implementation**

Upon finalisation of the design of a scheme, all drawings of the signs and marking scheme, all sign face design drawings and sketches, and the sign and post schedule should be packaged in a logical order and delivered to the client.

Those responsible for implementation of the project should ensure that all sign locations are checked on site at a suitable stage of construction (e.g. when the road formation is substantially complete) and amend the schedule if necessary prior to placing orders for sign posts or supports.
Section 3.5.1 – General

The following information is required for the preparation of route plans:

- The sign matrix (refer to Clause 2.1 in the VicRoads Supplement to AS 1742.15:2007). This is used to determine whether advance direction, intersection direction and reassurance or stand-alone route number signs are permitted or required at intersections.
- Standard Through Destination maps for the area (refer to Attachment A in the VicRoads Supplement to AS 1742.15:2007). These maps are used to determine what destinations are to be shown on direction signs.
- General rules for the design and erection of signs shall follow guidance found in AS 1742.15, AS 1743 and the VicRoads Supplement to those parts.

Section 4.1 – Development of New Signs


Section 4.2.1 – Regulatory Signs

Regulatory signs in Victoria generally have specific legal significance under the Road Safety (Traffic Management) Regulations 2009. These regulations incorporate the Road Safety Road Rules 2009, which is Victoria’s version of the Australian Road Rules. Thus, these regulatory signs must be sited and maintained so as to give the driver, or other applicable road user, every opportunity to obey the law or instruction.

Section 4.3.6 – Letter Types and Spacing

Due to the revised fonts as outline in AS 1744:2015, ‘narrow’, ‘medium’ and ‘wide’ spacing between letters are no longer available. A uniformed spacing distance between letters is now specified for all fonts.

For further information regarding the letter types and spacing used on signs in Victoria, refer to the VicRoads Supplement to AS 1743.

Section 5.2.1 – General Characteristics

Colour and contrast ratio

Use of coloured words or letters on VMS

The purpose of this guidance is to assist practitioners on the use of coloured words & letters on Variable Message Signs (VMS).

Background

The use of technology to manage the road network has advanced in many areas in a relatively short period of time. One such area has been the use of VMS. Technology advances now see many products on offer with capabilities such as a wide range of colour choice and ability to show symbols and images.

Guidance on the appropriate use of VMS is included in:

- Austroads Guide to Traffic Management Part 10
- Australian Standards AS 4852.1&2 & AS 1742.3
- Code of Practice for Worksite Traffic Management
- TCS015-6-2013: The Supply of Variable Message Signs for Freeways

However, guidance and research on the use of coloured words and letters on VMS is somewhat limited.

Literature Review

There is limited research on the use of coloured words or letters on VMS for road works.

Research undertaken by Chien-Jung Lai (2009) in Taiwan suggests that colour scheme and number of message lines are significant factors for motorists’ response time. Motorists responded faster to two colours...
than for one-colour and three-color schemes. Motorists also took less response time for double line messages than for single and triple line messages.

Research commissioned by ARRB for VicRoads (1991) shows that internally illuminated displays were the most legible during daylight, and green LED at night. However, weather conditions may vary or have a significant impact on using a particular colour during the day or night. Also, the technology of VMS has changed significantly since 1991 and this may have an impact on the actual effectiveness of multi-coloured messages.

A report produced by Traffic Works P/L (2010) titled “M80 Ring Road Upgrade: Use of multi-coloured VMS in work zones” refers to research by Gao, et. al, (2005) and Marktechopto, (2010). The Gao, et al report stated that when multi-coloured VMS are used, the colours and messages should correspond with each other, e.g. use yellow for warning, red to stop/lane end, and green to proceed/guide. Also, colour and shape are dominant visual features associated with traffic signs and allow motorists to disseminate key driver information.

The Marktechopto research stated that there is a significant proportion of the population that is colour-blind and that red is the first colour to be lost, due to its wavelength being at the upper end of the visible light spectrum. To remedy this issue, the colours red and green were mixed in the VMS.

As a trial over four years, the VicRoads M80 Ring Road Project has been using multi-coloured VMS (using red, green, amber and white) for road works on the M80 Ring Road, West Gate Freeway and Monash Freeway. The guidance for using each colour of the message has been documented in the “Traffic Management Strategic Principles (January 2015)”. During the implementation of multi-coloured VMS, it was observed that there was no detrimental impact on motorists’ behaviour upon observing the message displayed on these VMS.

Guiding principle

The guiding principle is that the words and letters on VMS are to be clear and comprehensible.

This principle shall apply to the use of coloured words and letters on VMS in addition to the many other principles that apply to other aspects of VMS which includes need, location and type/style of messages.

Guidelines

The guidance outlined in this section provides what is considered to be best practice for the use of coloured words or letters on variable message signs. Variation from these guidelines can be made provided they are consistent with the guiding principle.

In accordance with Section 5.2.1 in AGTM 10, best practice for colours for words and letters on VMS is yellow or white. While the research is somewhat limited, yellow and white coloured words and letters do seem to provide the best legibility for a wide range of weather conditions (e.g. from bright sunny days, during wet weather and through to night time conditions). Current use of VMS on the road network and theory on colour contrast seems to also support this.

DEPARTURE

AGTM 10 Section 5.2.1 also specifies that the colour of pixels used for VMS legends must be either yellow or white. Other colours may be used to replicate regulatory signs and for pictograms and other symbols.

However, there is some research (and also from the M80 Ring Road trial) that other colour combinations can be used effectively. For example, using one line of red and green, where red is used for important/restriction/direction words and green is used for positive/advice/information words.

The guidance below is provided to practitioners for the consideration of coloured words and letters other than yellow and white:

- The selection of non-standard colours may be given consideration as some colours are easier to see than others. Some colours are easier to see at night while others are easier to see during the day (such as brown). Therefore practitioners shall give consideration to the time and duration that the VMS is intended to be used.
- The selection of colours shall give consideration to colour contrast. VMS boards are “black”. Some colours are easier to see against a black background than others.
- Guidelines on luminance are provided in AS 4852.2:2009.
- The selection of colours should consider the type, size and style of fonts displayed.
• Consideration of the M80 report “Traffic Management Strategic Principles, Jan 2015” should be given when considering the use of mixed colours.
• With the selection of mixed colours, consideration shall be given to the road environment that they are to be used in. The use of colours that match with nearby traffic control devices should be avoided. For example the use of red and green in a VMS near traffic signals may potentially create issues.
• After installing a VMS, a drive through of the site shall be undertaken to check the legibility of the signs. The VMS display requirements should be in accordance with AS 4852.2:2009 Table 3.1 Display and Optical Requirements, as detailed in Appendix B.
• Consideration shall be given to the luminance of the VMS in accordance with the AS 4852.2:2009 Appendix A.
• If there is community concern on the ‘legibility’ of the VMS, it shall be reviewed to consider the colour choice being reverted back to yellow or white. Another drive through of the site should be undertaken to check the legibility of the VMS, in accordance with AS 4852.2:2009 Table 3.1 Display and Optical Requirements, as detailed in Appendix B.
• The results of this assessment shall be considered against the principles and any reason(s) to proceed shall be documented.
• When using non-standard colours, approval should be obtained from the relevant delegated authorised officer.

Figure 4: Coloured words on a Variable Message Sign

Section 6.2.2 – Reflectorisation
All pavement markings used on VicRoads controlled roads are reflectorised using glass beads. The purpose of the glass beads is to provide night-time visibility and skid resistance.

Glass beads may be either:
• 'drop-on', which are 'dropped' onto pavement marking materials as they are being applied. The size of drop-on glass beads can vary from 0.4 mm to larger than 1.0 mm, depending on the thickness of material application. As a general rule, the wet film thickness should be at least 60% of the nominal diameter of the drop-on glass beads when used for longitudinal line marking. Generally the larger the glass bead, the better the wet night-time visibility
• 'pre-mixed' with long-life pavement marking materials used. It should be noted that drop-on beads must also be used when applying long-life materials to provide initial night-time visibility and skid resistance, as the pre-mixed beads are not effective until traffic travelling on the line causes the beads to be exposed.

Section 6.3 – Linemarking Materials

Water-borne paint

Typically, the application rate of this material is 300 micron dry film thickness with standard size and large glass beads. Reference should be made to VicRoads Standard Specifications for actual application rates for paint and glass beads (see specification Section 721 (2012)).

Glass beads are ‘dropped’ onto water-borne paints to provide night-time visibility and skid resistance.

Solvent-borne paint

Solvent-borne paint is sometimes used for an initial application on chip seal surfaces as an alternative to water-borne paint.

The application rate of solvent-borne paint is normally 200 to 300 micron dry film thickness. Reference should be made to VicRoads Standard Specifications for specific requirements (see specification Section 721 (2012)).

Thermoplastic materials

Thermoplastic material is heated prior to application and is normally sprayed, extruded or screeded onto the pavement. Glass beads are pre-mixed into the product as part of the manufacturing process, with additional drop-on beads being used during the application to provide initial night-time visibility and skid resistance.

Thermoplastic material is normally placed around 2 mm thick when sprayed or extruded, and 3 mm thick when screeded. Reference should be made to VicRoads Standard Specifications for actual application rates (see Specification Section 721 (2012)).

Preformed thermoplastic road markings may also be used. These are in the form of lines, symbols or legends and are affixed to the road surface by heat application.

Thermoplastic road marking paint is also used to produce audio tactile edge lines.

Cold applied plastic materials

Cold applied plastic material is a two-part liquid mix comprised of a poly methyl methacrylate resin-based material and a hardener. It can be sprayed or screeded onto the pavement. Glass beads are pre-mixed into the product as part of the manufacturing process, with additional drop-on beads being used during application, as for thermoplastic materials.

Cold applied plastic material is generally used for road marking within intersections because of its high wear resistance. It is normally placed 1 to 2 mm thick. Reference should be made to VicRoads Standard Specifications for specific requirements (see Specification Section 721 (2012)).

Pliant polymer tapes

Pliant Polymer Tapes are preformed material in the form of tapes, symbols or legends. These tapes have an adhesive backing and are generally attached to the road surface by mechanical application or rolled into the new asphalt surfaces as they are placed.

As pliant polymer tapes are expensive, their use is limited to situations where the road has to be quickly marked after construction. Their general use is for pavement markings within intersections.

Glass beads

Glass beads used in association with the pavement marking paints or long-life materials provide the night-time visibility. Generally bigger and high quality beads provide increased retroreflectivity and increased life resulting in improved road safety benefits. Larger glass beads may need increased marking material thickness to provide the optimum degree of bead embedment and maximum retroreflectivity of the individual glass spheres. This occurs when 60% of the bead is below the surface of the pavement marking material and 40% is above.
Specialist treatments using materials with improved performance in wet conditions and quartz chippings for increased skid resistance are also available, but specialist advice should be sought for their use.

Section 8.3.2 – Sequences with Arrow Aspects

In addition to the display sequences shown in Figure 8.18 to Figure 8.24 of AGTM Part 10 (to initiate and terminate arrow controlled turn movements) two right turn treatments known as Partially Controlled Right Turn and, Partially Controlled Right Turn with Red Arrow Drop Out exist. Descriptions of these methods of control are provided within Section 7.3.3 of the VicRoads Supplement to AGTM Part 9, and the associated display sequences are shown in Figure 5 and Figure 6 below.

![Figure 5: Partially controlled right turn](image-url)
Figure 6: Partially controlled turn with red arrow drop out
Section 8.3.6 – Pedestrian Signals
For information regarding pedestrian signal lanterns and pedestrian push buttons, refer to Clause 4.2.4 and Clause 5.6 of AS 1742.14:2014, respectively.

For information regarding signal phasing for pedestrians, refer to Section 7.3.2 of AGTM Part 9 (2014).

Section 8.3.7 – Bicycle Signals
For information regarding bicycle signals at signalised crossings, refer to Clause 4.2.5 of AS 1742.14:2014.

Section 8.3.8 – Special Vehicle Signals
Tram Auto Points
At tram line junctions the tram operator may install tram signal equipment and a controller to automatically switch the tram points. A connection is needed between the tram and VicRoads controllers to allow the tram phases to be called. Also a back-up push button is needed at a convenient location to allow the tram driver to call the tram phase if the tram system fails.

The procedure for installing tram automatic points is that the tram operator will send to VicRoads a copy of the layout of the automatic points equipment showing the locations of the controller cabinet. The tram operator arranges a signal remodel plan showing:

- the back-up push button location
- the tram cabinet location
- the location of a 50 mm duct between the tram controller and the nearest traffic signals conduit pit
- the tram auto points lanterns.

The tram auto points lanterns should not be installed on a pedestal or pole with traffic signal lanterns.

For a straightforward job, the draft stage may be skipped. A quotation should be obtained if the job is not straightforward and the tram operator advised of the cost. The cost of all works is charged to the tram operator.

The tram operator shall submit the traffic signal remodel plan to the relevant VicRoads Region to review/approve the plan. The tram operator shall organise for a VicRoads approved signal contractor to connect the tram auto points outputs to the traffic signal controller and install the new EPROM. The Road Operations division of VicRoads prepares the new EPROM for the tram auto points.

Section 8.3.9 – Signal Start-up and Failure Displays
A single flashing yellow light occurs when intersection traffic control signals stop normal operation. The regulations state that a display by a traffic control signal of intermittent single yellow flashes is an instruction that a driver must approach, enter and pass through the intersection with caution.

Rules 63, 64 and 65 of Road Safety Road Rules 2009 cover a single yellow flashing light (including a flashing yellow arrow signal).

A single flashing yellow light is a Major Traffic Control Device (MTCD) and its installation requires written authorisation from VicRoads.
Section 8.4.1 – Designation of Signal Faces

Desirably a minimum of three circular displays or two turn displays should be visible when approaching an intersection and two displays should be visible when stopped.

Refer to Clause 4.2.1 of AS 1742.14:2014 for information regarding the location and number of signal displays at intersections.

Refer to Clause 4.1.4 of AS 1742.14:2014 for information regarding the use of mast arms for overhead signal faces.

Section 8.4.3 – Signal Face Site Requirements

Overhead secondary lanterns are generally not provided in Victoria. Where overhead primary lanterns are provided on an undivided road, right turn lanterns are generally not provided for the opposing approach (the default overhead secondary lanterns).

Dual (far right) secondary lanterns should be provided wherever possible, especially for fully controlled right turns and/or larger intersections.

Section 8.4.4 – Position of Signal Equipment

For information regarding positioning and type of signal pedestals, as well as required sight distance to signal pedestals, refer to Clause 4.2.1 of AS 1742.14:2014.

A typical signal layout plan is shown in Figure 7.

Items that must be added to the plan are:

- **Controller**
  A position is chosen where the controller lies:
  - Close to low voltage power source (240 volts) and a telephone cable pit.
  - Clear of running traffic on the protected side of roadside objects.
  - At a prominent secure location where the maintenance vehicle can safely stop and park and there is a good view of all approaches.
  - In shade or shelter.

- **Point of Supply**
  A suitable electricity supply authority pole which has 240V supply available is selected for the supply point. In remote areas a transformer is required if only high voltage supply is available at the site. When the point of supply is confirmed, the notation on the plan shall read “Confirmed point of supply (Wholesaler’s reference no. for supply XXXX)”, replacing the “proposed point of supply notation”.

- **Connection to Telephone Company**
  A nearby small telephone cable pit is selected as an initial estimate for an appropriate location to obtain connection to SCATS. Where a telephone connection is unavailable, connection to SCATS is via a 3G modem.

  Where a telephone connection is confirmed (e.g. if a Telstra line is being used), the notation on the traffic signal plan should read "Confirmed Telstra line connection (GPS coordinates for Telstra X,Y)". This is to replace the notation on the signal plan that reads "Proposed Telstra Connection", once the connection is confirmed.
• **Cable pits and conduits**
  Two cable pits are located on each corner for termination of the underground conduit for storage of a spare one metre loop of cable used in case of cable damage. A 100 mm conduit (category A PVC) is shown between each cable pit, connecting to the controller. Sometimes on a large intersection twin, 100 mm conduits may be required to house the power and detector cables between the controller and the nearest cable pit. The conduit layout from the controller to the point of supply consists of a 50 mm conduit between the controller and distribution cabinet, and a 63 mm conduit from the distribution cabinet to the point of supply. VESI pits are also required to be installed for JUPs and JUMAs for public lighting.

• **Detector Pits**
  Add detector pits at back of kerb, 8 m from the stop line and in the median if required. A 50 mm conduit is installed from the detector pit to the nearest cable pit. This conduit is not shown on the plan but covered in the contract specification. A maximum of three loops can be fed to each detector pit and if there are more than three lanes on a divided road, detector pits should be located both sides of the road.
Figure 7: Typical signal layout
Section 8.4.6 – Lantern Mounting Heights

For some starting or manoeuvring lanterns the mounting height may be reduced to 3 m for all lanterns in that display. Refer ITS Standard drawing TC-1116.

VicRoads uses signal pedestals designated 2B for 4.1 m mounting height and 2A for 3.25 m mounting height. ITS Standard drawing TC-1100 shows the dimensions for 2B and 2A pedestals. Generally, 2B pedestals are used for all lanterns.

ITS Standard drawing TC-1126 shows lantern mountings under verandas.

Section 8.4.10 – Other Street Furniture

Joint-use supports for side mounted signs

Multi-purpose poles are available to reduce the number of poles as follows:

- Joint use poles (JUP) - to support traffic signals and street lighting lamps available in 8.5, 11 and 13.5 metre heights.
- Joint use mast arms (JUMA) - to support traffic signals and street lighting lamps. Available 5.5 m clearance height, 2.5 m, 3.7 m and 5.5 m length of outreach, and 8.5, 11 or 13.5 m street lighting pole heights.
- Multi-purpose poles/mast arms (JUTP) - that will support traffic signals, street lighting, tram operator overhead cables, power lines.

Often existing electricity supply authority and tramway poles can be used to support traffic signal hardware, subject to the agreement of the asset owner. Poles need to be specifically designed to mount mast arm outreaches.

Wherever practicable in urban areas, signs should be mounted onto existing utility poles to reduce any unsightly proliferation of poles in the environment.

When contemplating the use of joint-use supports for signs it is necessary to ensure that:

- the function of the sign is not adversely affected by relocating it on a joint-use support
- all required lateral and vertical clearances are provided, see Appendix D2.3 of AS 1742.2:2009
- permission is obtained for use of structures which are not VicRoads property.

For further information on joint use poles, refer to VicRoads specification TCS 001.

Section 8.5.1 – Advance Warning Signals

For additional guidance on the use of advance warning signals, refer to Appendix E of AS 1742.2:2009.

In addition to the purposes for active advance warning signals shown in the AGTM, VicRoads also installs these signs in isolated rural locations, where traffic signals may not be expected.

Section 8.5.2 – Railway Level Crossings

If traffic or pedestrian signals are located close to a railway crossing, an interlink between the traffic signals and railway signals is often necessary. This link will ensure that the traffic signals will not cause any vehicles to store on the railway lines when a train is approaching.

Most traffic signals installed close to or across railway lines require a fairly complex phasing system to ensure that vehicles do not queue across the railway lines. For efficient operation careful consideration should be given to achieving the maximum road capacity (number of lanes, exclusive turn lanes) and the maximum use of complementary (overlap) vehicle and pedestrian phases. Clearance phases are not used after train phases.

Note that roundabouts have been successfully used next to railway crossings even though the roundabout may be blocked during train movements.
Section 8.5.3 – Emergency Vehicle Facilities

To enable safe and efficient movement of emergency vehicles from their depot, traffic signals may be installed (at the cost of the emergency vehicle authority). Where the emergency vehicle facility is located at an intersection controlled by traffic signals an all red phase is usually incorporated and this is called from within the emergency vehicle depot.

Where the emergency vehicle facility is located near an existing intersection controlled by traffic signals, emergency vehicle signals are installed at the emergency depot and connected to the adjacent signalised intersection. An emergency clearance phase is also incorporated at the signalised intersection.

Usually standalone emergency vehicle signals are considered when at least one of the following conditions is met:

- the depot is located on an arterial road
- there is documented evidence of crashes between exiting emergency vehicles and road traffic in the past five years
- at least 6,000 vpd use the main road
- an average of 20 emergency departures is made each week.

**DEPARTURE**

In Victoria, the operation of traffic signals at emergency vehicle facilities differs from the operation described in the AGTM in that:

- VicRoads has moved away from the double flashing red lights as, at some sites, not all vehicles stopped when the signals operated.
- VicRoads does not permit the three-aspect signal face to revert to blank as it could encourage motorists to assume that the signals are faulty, and possibly cause confusion when the signals are activated.

As such, the ‘non-flashing’ and ‘flashing’ signal modes as described under ‘signals for mid block access points’ are not used.

Emergency vehicle signals are treated as normal signals with standard three-aspect displays on the main road. When there is no demand from an emergency vehicle these displays remain green. When an emergency vehicle demands the emergency phase the sequence of operation is as follows:

- the main road signals are green
- an emergency call is made from a button in the premises or by a vehicle (note: there may be a delay time from when the call is initially made and the signals reacting to the call. This will depend on the specific set up of the installation)
- the main road signals change to yellow once the call is registered (yellow time is determined as per normal standards),
- the main road signals change to red (all red time is determined as per normal standards),
- a white E display is shown to the emergency premises (as per AS 1742.14:2014 Clause 2.6)
- the white E display is terminated after the cancel button is operated in the premises (or the emergency phase terminates after a maximum time)
- an appropriate clearance time operates at the end of the E display
- the main road signals return to green and remain green until the next emergency call.

Section 8.5.4 – Public Transport Priority

Bus priority

In Victoria, a single white ‘B’ lantern can also be used (as opposed to a three-aspect column) to control exclusive bus phases. The selection of either a single or three-aspect display is dependent on whether there is a need to control bus and general traffic independently at all times.

Section 8.5.5 – Bicycle Facilities

The different types of detection which may be used for cyclists are:

- pedestrian push buttons
- rectangular path/lane loops
- slanted lane loops

A slanted multilane loop in advance of the symmetripole lane loops is recommended to ensure bicycles are detected. A slanted lane loop across multiple lanes is shown in Figure 8. On Principal Bicycle Routes, the detection of bicycles using a slanted detection loop may be necessary in the following cases:

- in lanes where there are turning phases
- on side roads where vehicle loops may not always be activated. For an intersection without turning phases, bicycle detection is not necessary on the main road as the main road phase has a permanent demand placed on it by the controller.

![Figure 8: Bicycle loop on a side road](image)

Section 8.5.9 – Paired Intersections

Staggered ‘T’ intersections

These types of intersections should be avoided because they operate very inefficiently when signalised. The reasons are that the cross streets usually require separate phases and rear end collisions often occur on the major road due to the closely spaced stop lines.

Section 8.5.12 – Single-Lane Operation and Portable Signals

A Memorandum of Authorisation from VicRoads is required to operate portable traffic signals on worksites.
Section 8.8.2 – Signs at Signal Installations

U-turn Permitted sign
The R2-15 U-turn Permitted sign is not often used at signalised intersections in Victoria, as U-turns are generally allowed at traffic signals under the Road Safety Road Rules 2009 (unless otherwise signed).

**DEPARTURE**

Turn left at any time with care sign
As per AS 1742.14:2014 Table 6.1, the turn left at any time with care sign (R2-16) is no longer used. It is expected that all drivers will use the appropriate amount of care when turning from the slip lane regardless of the presence of the sign.

**DEPARTURE**

Left turn on red permitted after stopping sign
Left turn on red is not used in Victoria. An explanation for this can be found in Clause 7.5 of the VicRoads Supplement to AS 1742.14:2014.

Section 9.1 – Flush Medians and Islands
Typical pedestrian behaviour is to use a direct route between two points, even at increased risk. Medians help reduce the risk.
Medians should be kerbed or ‘raised’ (except on freeways, where kerbs increase the severity of any crash). On traffic routes, semi-mountable kerbing should be used.
Where a kerbed median cannot be provided in an urban area, a painted median will usually require refuge islands at intervals, to create adequate separation of traffic and refuge space for pedestrians.
4. Additional Information – Electronic Signs

Traveller Information Signs

The purpose of this guidance is to assist practitioners in determining high priority locations for traveller information signs and use them in the most effective manner.

a) Background

For a simple trip of getting from A to B, there are a number of choices each traveller must make, such as:

- destination (e.g. where to shop)
- time of day to depart
- mode
- route

Stepping back further, the traveller has already made a number of decisions that impact their travel such as their home and work locations. Appreciating the full context of traveller decisions is important in understanding how road authorities can influence traveller behaviour through providing information during a journey. The importance of habit becomes clear as travellers do not assess these decisions in full before each and every trip. Indeed, research indicates that the most likely time that travellers will reassess their trip choices is at a time of another change in life, such as a change in home or work location but that behaviour is substantially habitual at other times.

This impact of habit and familiarity continues once travellers are underway on their journeys. As such it cannot be assumed that by filling an information gap we will entice travellers to change their route or mode while en-route. Market research conducted for VicRoads as part of Keeping Melbourne Moving highlighted the reluctance of many travellers to change their route from what they were familiar with. This extended to a significant proportion of travellers choosing to remain on their familiar route even if advised of significant delays.

In a study in Calgary1, Canada, where there were clear alternative routes to the freeway in question, only 15% of travellers said that they would ‘always re-route’ when provided with information about congestion, roadwork or a crash ahead, with 66% occasionally re-routing and 18% never re-routing. Other studies cited in this paper, found that even when the displayed message informed drivers that the road was closed ahead, 30% of drivers would still not re-route.

There are a number of factors influencing whether the large group of travellers in the ‘occasionally re-route’ category will re-route in any given circumstance. This includes the nature of the delay advised and their knowledge of the alternative route(s). Much literature indicates that drivers will be more likely to re-route if the VMS provides alternative route information, however this can be very difficult to do in a city like Melbourne where there are dispersed destinations.

Austroads research on traveller information

Similar results to the Calgary study were found in a 2008 quantitative survey of Australian road users conducted for Austroads2. In this study, familiarity with the area (and hence alternative routes) was found to be a key factor.

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2 Austroads (2008) NS1149 Traveller Information – Stage 4 Reporting Quantitative Survey With Drivers
Table 2: Likelihood of motorists changing route due to “Delay” or “Crash Ahead” message

<table>
<thead>
<tr>
<th>Sample = aware of VMS (n=1223)</th>
<th>Very</th>
<th>Fairly</th>
<th>Unlikely</th>
<th>Very Unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will you change route?</td>
<td>%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In an area you know well</td>
<td>65</td>
<td>26</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>In an area you don’t know well</td>
<td>11</td>
<td>29</td>
<td>46</td>
<td>15</td>
</tr>
<tr>
<td>If delays were likely to be 5 mins</td>
<td>7</td>
<td>26</td>
<td>50</td>
<td>17</td>
</tr>
<tr>
<td>If delays were likely to be 10 mins</td>
<td>15</td>
<td>44</td>
<td>35</td>
<td>5</td>
</tr>
<tr>
<td>If delays were likely 30 minutes</td>
<td>58</td>
<td>37</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>If delays were likely an hour +</td>
<td>82</td>
<td>15</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>If the term detour was used</td>
<td>44</td>
<td>46</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>If the term diversion was used</td>
<td>26</td>
<td>52</td>
<td>19</td>
<td>3</td>
</tr>
</tbody>
</table>

The study concluded that:

Most drivers (91%) were very or fairly likely to take the advice of VMS signs when they were in an area they knew well. This dropped down to only 40% in areas where they weren’t so familiar. Similarly, as the length of expected delay increased, more and more of our drivers would take the advice of VMS.

All this indicates that the likelihood of taking actions varies somewhat. For instance in an area which the driver knows, the incidence of being likely to turn off the road and take an alternative route is high, but this decreases somewhat when the area is unknown.

Reflecting the varying decisions drivers are likely to make in such varying context, the expected time delay strongly influences the likelihood of turning off the road – with short delays significant numbers wouldn’t take any actions, while when expected delays increase beyond 30 minutes the numbers taking an alternative route (if available) rise significantly.

Lastly, the word ‘detour’ would appear to be a somewhat more significant motivator to action than the word ‘diversion’.

Potential for VMS to improve customer journey experience

Influencing travel choices and re-routing are not the only ways that VMS can improve customer journey experiences. Another important aspect is that of reassurance – providing the traveller with additional confidence to overcome uncertainty about conditions ahead. The value of knowing about delays (or lack of delays) is well established in public transport literature and has contributed to the rollout of roadside signs and mobile apps with next bus, tram and train information.

This impact of reassurance on better journey experiences is also reflected in the 2008 Austroads research, where responses were much stronger on whether they found information useful compared to whether they would take action in response.
Table 3: Likelihood of motorists changing route due to “Delay” or “Crash Ahead” message

<table>
<thead>
<tr>
<th>Message</th>
<th>Message Rated ‘Useful’ or ‘Very Useful’</th>
<th>Message Rated ‘Very Useful’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicating to use alternative route (e.g. incident ahead)</td>
<td>98%</td>
<td>70%</td>
</tr>
<tr>
<td>“Roadworks Ahead Today”</td>
<td>97%</td>
<td>68%</td>
</tr>
<tr>
<td>Advising of expected delays due to heavy traffic or an incident</td>
<td>96%</td>
<td>72%</td>
</tr>
<tr>
<td>Advising of school zone in operation</td>
<td>95%</td>
<td>63%</td>
</tr>
<tr>
<td>Advising of upcoming roadworks giving information</td>
<td>95%</td>
<td>57%</td>
</tr>
<tr>
<td>Advising of the current speed limit</td>
<td>93%</td>
<td>61%</td>
</tr>
<tr>
<td>Advising of general traffic conditions ahead</td>
<td>93%</td>
<td>55%</td>
</tr>
<tr>
<td>Advising of upcoming events that may cause delays</td>
<td>91%</td>
<td>42%</td>
</tr>
</tbody>
</table>

These positive responses mean that VMS can be useful in improving customer journey experiences in a wide range of situations, not only when there is a major incident taking place.

**VicRoads VMS message practice**

VicRoads’ ITS platform based around the STREAMS software includes VMS message tools, travel time display tools and a Strategy Manager that allow messages to be automatically selected for display to maximise their relevance to traveller journeys at that time. This means that signs can be set to display travel time information (where available) normally, automatically update to a more tailored delay message when unusual congestion occurs and be set as part of an incident response in a semi-automated way when operators set up an incident in the system.

Catering for multiple display purposes with different levels of importance ties in well with VicRoads’ guidance on traveller information. The image below is taken from Section 4.5.2.2 of the VicRoads Managed Freeways Handbook for Traveller Information.

*Figure 9: VicRoads’ message priorities as outlined in the Managed Freeways Handbook*

This use of travel time messages adds substantial benefits to a VMS site by allowing much longer periods of beneficial use, even if the use at that time is less valuable than during a major incident.
Decision point principles

After considering the available guidance from existing sources and considering the way in which motorists respond to the messages, the following criteria for selecting key decision points have been developed:

- the number of motorists who will travel past the sign
- how often is an incident expected to occur on the route, where a message could benefit motorists;
- how much benefit in terms of travel time savings could be experienced by a motorist observing the message
- the significance of the destinations reached via the route
- the viability of alternative arterial routes
- the connectivity of the network ahead of the sign.

In addition to decision points for alternate routes, consideration should be given to the value of providing travel time information along the route for reassurance purposes, as highlighted in Section 2.2.

VMS siting guidelines

There are four types of real time information signs that are currently used by VicRoads on the metropolitan Melbourne road network. These include:

- Freeway mainline Variable Message Signs (Freeway VMS)
- Arterial road Variable Message Signs (Arterial VMS)
- Real Time Information Signs (RTIS) using RC3 panels on arterial roads before freeway entry ramps; and
- Advance Real Time Information Signs (ARTIS) also using RC3 panels on arterial roads but as the name suggests located some distance in advance of the freeway.

Each type of sign has a different purpose and is used in differing situations. Some other sign types remain in use but are not used for new installations, such as:

- Trip Information Signs (TIS) often referred to as DriveTime signs
- Trip Condition Signs (TCS) also often referred to as DriveTime signs
- Freeway Condition Signs (FCS) used as inserts in direction signs.

Examples of each of the signs currently available for use are illustrated below.

Figure 10: A freeway VMS showing a travel time message

Figure 11: A freeway VMS showing an incident message
Freeway VMS

Purpose

Freeway VMS are used to provide real time changeable advice to road users about the current (or future) conditions along a freeway. The signs are generally used as part of incident and event management and may complement lane use management system (LUMS) where applicable on freeways to provide consistent advice to motorists.

Guidelines for locating freeway VMS

Typical guidelines for longitudinal placement of a Freeway VMS are as follows:

- On a freeway, signs are generally located 900 m to 1200 m prior to major decision points (minimum 300 m). This provides adequate time for motorists to read, comprehend and act on the information provided which may involve braking and/or manoeuvring. Major decision points include freeway interchanges and significant exit ramps which may be used for the diversion of traffic. It is noted that a shorter distance could be used for lower speed environments.
- This 900 m to 1200 m distance from the exit may be insufficient to prepare drivers to change their route and would ideally be complemented by using a further VMS 2-4 km upstream to prepare drivers to take the required action.
- at least 200 m prior to a LUMS environment to support and advise of lane closures or reduced speed limits
- at least 200 m from static directional signs
- a minimum of 500 m beyond an entry ramp (nose) to avoid installing the sign in the vicinity of the location where traffic is merging. This is to avoid the sign distracting motorists at the location where vehicles are completing merging movements.
- located on straight sections of road in order to ensure that the necessary visibility requirements are met. Minor curves in the road can impede visibility to the signs, especially on roads with noise barriers or kerbside vegetation.
Arterial VMS

Purpose

The purpose of Arterial VMS is similar to Freeway VMS and so they are used to display incident, works and special event messages on arterial roads. An opportunity exists to use these signs for travel time messages.

Guidelines for locating Arterial VMS

Guidelines for placement of an arterial VMS are modelled on Freeway VMS, e.g.:

- Locate the VMS 300-500 m in advance of the major decision point, although as with freeway VMS a longer distance may allow greater time for motorists to process a required route change.
- At least 150 m from static directional signs.

Real Time Information Signs (RTIS)

Purpose

Real Time Information Signs (RTIS) also referred to as RC3 provide advance warning and an information component of traveller information to motorists before accessing a freeway. The signs provide travel time information as well as integrated messages associated with freeway ramp signals and lane use management system (LUMS) operation.

The RTIS display travel time information as a default message for the freeway routes downstream from the interchange. The RTIS are able to display a variety of messages that are compatible with the operation of the freeway LUMS and VMS including freeway condition, incidents/events and freeway closure information.

Guidelines for RTIS on freeway approaches

- Provide separate RTIS for all turning movements onto the freeway at interchanges where ramp signals are provided.
- It is noted that signs may not be required if a low volume of traffic turns onto the freeway ramp or if the entry point is located near the end of the freeway.
- Locate signs on same side of the road as the movement (where possible).
- Location should be clear of sight distance restrictions (i.e. trees).

The following table outlines the minimum sign installation distances prior to the decision point to enable a road user to react appropriately:

Table 4: Minimum sign installation distances (based on AS1742.2:2009)

<table>
<thead>
<tr>
<th>Installation</th>
<th>Speed Environment (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60 and 70</td>
</tr>
<tr>
<td>Distance prior to action point</td>
<td>60 to 80 m</td>
</tr>
<tr>
<td>Spacing to other signs</td>
<td>50 m</td>
</tr>
<tr>
<td></td>
<td>Minimum 0.6 V m</td>
</tr>
<tr>
<td></td>
<td>(where V is the 85th percentile speed in km/h)</td>
</tr>
</tbody>
</table>

- If complex manoeuvres are required or there is a location where traffic may often be detoured, it is desirable to have the RTIS located 300-500 m in advance of the decision point. On high speed roads, this distance should be further increased to 2 km-4 km to provide a suitable amount of time for motorists to manoeuvre and act upon the message.
- Mounting height of the RTIS is generally a minimum of 2.5 m to the bottom of the sign to provide adequate clearance over pathways and to minimise potential vandalism.
• RTIS should not compete with other existing signage. When identifying locations for the RTIS to be installed, consideration should be given to the existing directional signage and traffic control devices. However, in some cases, there may be a need to relocate existing signage to accommodate the installation of a RTIS.

Opportunity for larger RTIS/ARTIS (RC3) signs

The current RC3 design is a result of careful consideration as to how to provide an optimised display for traveller information in a compact sign size that maximises opportunities for installation in crowded roadside environments. Nevertheless, although the 120 mm character height is legible in many arterial road speed environments, an opportunity exists for a larger sign size that maximises conspicuity and legibility. A larger sign may be upscaled to allow a 150-200 mm character height but whilst retaining the colour display and pixel density that provide for better traveller information message layouts relative to standard Arterial VMS.

Advance RTIS (ARTIS)

Purpose

Advance Real Time Information Signs (ARTIS) are used on the arterial road network in the vicinity of a freeway to provide real time information regarding the freeway traffic conditions.

These signs are generally located further from the freeway interchange in the vicinity of major arterial road intersections where alternative routes to the freeway are available to get to similar key destinations.

When ARTIS are used as substitutes for Freeway Condition Signs, they display a freeway traffic conditions message at the top of the sign and is shown in a particular colour depending on the conditions:

• Light Conditions – Green
• Medium Conditions – Yellow
• Heavy Conditions – Red
• Major Delays – Flashing Red.

The same colour themes are used on RTIS signs. Colour coded travel time information (presented in minutes) to chosen freeway destinations are also presented in the remaining area on the sign. The travel times incorporate the travel time on a freeway and the entry ramp to get to the destination, however it does not incorporate the travel time from the sign location to the freeway ramp.

It is noted that ARTIS are currently being used in Victoria in place of Freeway Condition Signs.

Guidelines for locating ARTIS

• The objective of positioning these signs is to provide information of the conditions on the freeway at key decision points to enable motorists to take an alternative route prior to committing to entering the freeway.
• ARTIS are generally installed at locations where other alternative parallel routes are available and provide an option to travel to similar key destinations when compared to travelling on the freeway.
• ARTIS are not required where no alternative route is available for motorists, provided there are RTIS signs at the freeway entry ramps.
• ARTIS are generally installed 50 to 100m in advance of associated directional signage in order to separate the freeway / arterial condition information from the directional signage information.
• Consideration to the positioning of the signage is required to ensure that the message is relayed to the correct motorists. For example, the sign is located on the left sign of the road it may only be able to provide information relating to the left turn movements at an intersection.
Identification of candidate sites

A corridor approach has been developed for the purposes of identifying candidate sites that have potential for being high priority locations. RTIS and RTIS on the network based on the Decision Point Principles identified previously in Section 3. The corridors that have been identified are generally high traffic volumes routes, where there identified alternative routes that could be used to lead to a common destination.

It is noted that existing VMS and RTIS installations generally follow the M1 and M80 corridors as well locations on the arterial road network within the inner suburbs that were installed around the time of the 2006 Commonwealth Games.

A set of plans are attached at Appendix A which show the existing VMS and RTIS locations as well as a number of candidate sites based on the Decision Point Principles discussed in this document. Overall there have been 57 candidate sites identified where existing VMS or RTIS are not already installed.

Princes Freeway West corridor

The Princes Freeway West corridor is generally well serviced by existing VMS and RTIS signs that were installed as part of the M1 Upgrade project.

There is one additional site which has been identified on this corridor, which would face westbound traffic between the Forsyth Road and Princes Highway interchanges in Hoppers Crossing. The purpose of this sign is to advise if there is an incident on the Maltby Bypass section of the freeway and if there would be a benefit in traffic diverting through Werribee. This site has been selected as there is a clearly defined arterial road alternative to the freeway that leads to the same destination to the west of Werribee.

Western Freeway corridor

There are two key decision points identified on the Western Freeway (M8) corridor for motorists travelling in an eastbound direction towards Melbourne, where suitable alternative arterial routes are available for potential diversion. These locations are noted below as candidate sites for VMS:

- West of the Ferris Road interchange in Melton, to advise eastbound traffic to divert to the Melton Highway in the event of an incident on the Western Freeway.
- West of the Ballarat Road interchange in Caroline Springs, to advise eastbound traffic to divert along Ballarat Road in the event of an incident in the Deer Park Bypass section of the Western Freeway.

Calder Freeway corridor

It is difficult to identify candidate sites on the Calder Freeway corridor, as there are limited alternative routes available which lead in a similar direction to common destinations.

The only candidate site that has been identified is a location to the north-west of the Gap Road interchange in Sunbury facing south-east bound traffic. A VMS in this location would advise traffic to detour via Gap Road and Sunbury Road to head towards Melbourne, in the event of an incident on the Calder Freeway.

Riddell Road

There are two alternative arterial routes that can be used from Sunbury to travel towards Melbourne, along Sunbury Road (C743) through the Bulla township to the Tullamarine Freeway, or via Vineyard Road (C706) to the Calder Freeway (M79).

A potential candidate site for a VMS would be to the west of the Macedon Street/Horne Street intersection, facing eastbound traffic, to advise if a faster travel time towards Melbourne is available via the Sunbury Road (C743) or Vineyard Road (C706) route.

Hume Freeway corridor

A candidate site identified for the Hume Freeway (M31) corridor is north of the Sydney Road interchange in Craigieburn, where a VMS facing southbound traffic could advise traffic to divert down Sydney Road, in the event of an incident on the Craigieburn Bypass section of the Hume Freeway.
Diamond Creek Road

There is a significant volume of south-westbound traffic that travels along Diamond Creek Road to access the Greensborough Bypass and M80 Ring Road. In the event of an incident on the Greensborough Bypass or the eastern section of the Ring Road, it is possible for traffic to deviate via Greensborough and Grimshaw Street to avoid this area. The identified candidate site is on Diamond Creek Road, facing south-westbound traffic, to the north-east of the roundabout at Civic Drive in Greensborough.

Main Road, Eltham

Main Road, Eltham is a route used by a large amount of traffic to access the Yarra River crossing on Fitzsimons Lane. A VMS could be located to the east of the Fitzsimons Lane roundabout, facing westbound traffic, to advise traffic to continue west along Lower Plenty Road, in the event of any incidents in the Templestowe area that would result in delays for traffic heading south on Fitzsimons Lane.

Doncaster Road

Doncaster Road essentially parallels the Eastern Freeway (M3) in the section between the Eastern Freeway in Balwyn North and Springvale Road in Donvale. To the west of the Balwyn North interchange, it is also possible to continue travelling towards Melbourne City along Doncaster Road and High Street in the event of an incident further west on the Eastern Freeway.

Candidate sites have been identified at the following locations on Doncaster Road and Mitcham Road to advise traffic to continue along this route instead of heading towards the Eastern Freeway in the event of an incident:

- west of the Eastern Freeway interchange on Doncaster Road in Balwyn North, facing eastbound traffic
- east of Springvale Road on Mitcham Road in Donvale, facing westbound traffic
- east of the Eastern Freeway interchange on Doncaster Road in Doncaster, facing westbound traffic.

Eastern Freeway corridor

Sections of the Eastern Freeway (M3) corridor are already served with VMS, however there are two candidate sites that have been identified where it would be possible to divert onto Doncaster Road in the event of an incident. These sites are located at:

- east of Springvale Road interchange in Donvale facing westbound traffic
- east of Doncaster Road interchange in Doncaster facing westbound traffic.

Melba Highway corridor

The Melba Highway (B300) is an important traffic route which is used by motorists to access regional and recreational areas to the north-east of Melbourne including alpine areas and Lake Eildon.

In the area south of Yarra Glen, there are two alternative routes that can be used to head towards Melbourne, either by continuing south along the Melba Highway and Maroondah Highway through Coldstream and Lilydale or by a local road route via McIntyre Lane and Victoria Road, which could be used in the event of an incident in Coldstream or Lilydale.

The identified candidate site is on Melba Highway, north of McIntyre Lane, facing southbound traffic.

Maroondah Highway corridor

The Maroondah Highway is one of a number of parallel arterial routes which runs through the eastern suburbs of Melbourne. There are a number of locations along this corridor where alternate routes are available, where VMS could be used to advise of the optimal route to provide the best travel time or to avoid an incident. These sites include:

- east of Springvale Road, facing westbound traffic, to advise whether to head towards the Eastern Freeway or continue along Maroondah Highway to head towards Melbourne
• west of EastLink, facing eastbound traffic, to advise whether to use the Ringwood Bypass or continue along Maroondah Highway through the Ringwood town centre to continue towards the east
• east of Mt Dandenong Road, facing westbound traffic, to advise whether to use the Ringwood Bypass or continue along Maroondah Highway through the Ringwood town centre to head towards Melbourne
• west of Mooroolbark Road, facing eastbound traffic, to advise whether to continue east along Maroondah Highway through Lilydale and Coldstream to access the Melba Highway or whether to use the local road connection along Victoria Road and McIntyre Lane
• east of Anderson Road, facing westbound traffic approaching Lilydale township, to advise whether it is more optimal to continue along Maroondah Highway to head towards Melbourne or to turn left into Anderson Street and travel via Swansea Road and Canterbury Road
• south of Melba Highway in Coldstream, facing northbound traffic, advising whether to travel via Melba Highway through Yarra Glen or Maroondah Highway through Healesville to access north-east Victoria, noting that although traffic volumes are lower in this area, there is a high risk of incidents where both roads cross the Great Dividing Range beyond Yarra Glen and Healesville.

Mount Dandenong Road
A candidate site is identified to benefit westbound traffic approaching the intersection at Maroondah Highway to advise of any incidents on the Ringwood Bypass and whether there would be a benefit for traffic to divert along the Maroondah Highway through Ringwood.

Canterbury Road
Canterbury Road is one of a number of parallel east-west routes that run through the eastern suburbs of Melbourne. The intersection at Bayswater Road is a common location used by traffic to divert onto Mountain Highway and Burwood Highway as an alternative route to travel west towards Melbourne.

A candidate site is identified on Canterbury Road to the east of Bayswater Road, facing westbound traffic, to advise on the optimal route with the lower travel time to head west towards Melbourne.

Burwood Highway corridor
Burwood Highway is one of a number of parallel arterial routes which runs through the eastern suburbs of Melbourne. There are two candidate sites located along Burwood Highway where it is considered that there is a high likelihood that traffic may divert to other parallel routes depending on traffic conditions:

• east of Ferntree Gully Road, facing westbound traffic, which could advise traffic to divert along Ferntree Gully Road to access the Monash Freeway when this provides lesser travel time to head west towards Melbourne
• east of the EastLink interchange, facing westbound traffic, to advise traffic of the option of diverting onto EastLink to access either the Monash or Eastern Freeways to travel towards Melbourne in the event of an incident on Burwood Highway.

Princes Freeway East and Monash Freeway corridor
The Princes Freeway East/Monash Freeway (M1) corridor is well served by existing VMS in the section to the west of Huntingdale Road. Between Huntingdale Road and Clyde Road there are RC3 signs at freeway interchanges, but no VMS that is visible to traffic on the freeway itself.

A number of decision points are identified on the Monash and Princes Freeways at locations where it is possible to transfer onto alternate routes, this includes locations at either end of the Pakenham, Berwick and Hallam Bypass sections and on the north-westbound approach to Wellington Road. The candidate sites are described in more detail below:

• east of Princes Highway interchange in Nar Nar Goon, facing westbound traffic, where a VMS could be used to divert traffic onto the Princes Highway through Pakenham in the event of an incident on the Pakenham Bypass section of the Princes Freeway
• west of Princes Highway interchange in Officer, facing eastbound traffic, where a VMS could be used to divert traffic onto the Princes Highway through Pakenham in the event of an incident on the Pakenham Bypass section of the Princes Freeway
• east of Princes Highway interchange in Narre Warren, facing westbound traffic, where a VMS could be used to divert traffic onto the Princes Highway through Hallam in the event of an incident on the Hallam Bypass section of the Princes Freeway
• west of Princes Highway interchange in Narre Warren, facing eastbound traffic, where a VMS could be used to divert traffic onto the Princes Highway through Berwick and Beaconsfield in the event of an incident on the Berwick Bypass section of the Princes Freeway
• west of South Gippsland Freeway interchange in Eumemmerring, facing eastbound traffic, where a VMS could be used to divert traffic onto the South Gippsland Freeway and Princes Highway through Hallam in the event of an incident on the Hallam Bypass section of the Princes Freeway. This sign could also be used to display the optimal route to Phillip Island, either along South Gippsland Freeway and South Gippsland Highway or via Princes Freeway and Healesville-Koo Wee Rup Road
• east of Wellington Road interchange in Mulgrave, facing westbound traffic, where a VMS could be used to divert traffic along Wellington Road and Princes Highway in the event of an incident on the Monash Freeway.

Princes Highway East corridor

The Princes Highway East corridor parallels the Princes Freeway East and Monash Freeway, between Nar Nar Goon and Melbourne. There are a number of locations where these routes cross each other or are located particularly close to each other which provide a good opportunity for motorists to transfer between routes which may be beneficial depending on traffic conditions.

ARTIS and RTIS already exist at a number of these locations that were installed as part of the M1 Upgrade project. The following additional candidate sites are identified for future VMS installations:

• Princes Highway, west of Brunt Road in Officer, facing westbound traffic, to advise whether it is beneficial to divert onto the Princes Freeway to head towards Melbourne or continue along the Princes Highway through Beaconsfield and Berwick
• Princes Highway, west of Westall Road in Clayton, facing westbound traffic, to advise whether it is beneficial to divert via Blackburn Road to the Monash Freeway to head towards Melbourne or continue along the Princes Highway.

South Gippsland Highway corridor

The South Gippsland Highway (M420) corridor is a major highway that runs to the south-east of Melbourne, which is used to access the South Gippsland region of Victoria and significant holiday destinations including Phillip Island. There are a number of alternative arterial routes that can be used to access the Princes Freeway East/Monash Freeway corridor from the South Gippsland Highway, including Healesville-Koo Wee Rup Road, Clyde Road or Narre Warren-Cranbourne Road or continuing along the South Gippsland Highway through Cranbourne.

The candidate sites for VMS installations include:

• South Gippsland Highway, east of Sybella Avenue in Koo Wee Rup, facing north-westbound traffic, to advise whether a more optimal route towards Melbourne is via Healesville-Koo Wee Rup Road to the Princes Freeway or continuing along the South Gippsland Highway
• South Gippsland Highway, east of Clyde-Fiveways Road in Five Ways, facing north-westbound traffic, to advise whether a more optimal route towards Melbourne is via Clyde Road to the Princes Freeway or continuing along the South Gippsland Highway through Cranbourne
• South Gippsland Highway, east of Cameron Street in Cranbourne East, facing north-westbound traffic, to advise whether a more optimal route towards Melbourne is via Narre Warren-Cranbourne Road to the Monash Freeway or continuing along the South Gippsland Highway through Cranbourne
• South Gippsland Highway, east of the South Gippsland Freeway in Hampton Park, facing north-westbound traffic, to advise whether a more optimal route towards Melbourne is via the South Gippsland Freeway to the Monash Freeway or continuing along the South Gippsland Highway and the Princes Highway through Dandenong.

• South Gippsland Highway, south-east of the Dandenong Bypass in Dandenong South, facing north-westbound traffic, to advise whether a more optimal route towards Melbourne is via the Dandenong Bypass and Westall Road or continuing along the South Gippsland Highway and the Princes Highway through Dandenong.

**Western Port Highway corridor**

The Western Port Highway (M780) corridor is an important highway that serves the Port of Hastings. Important decision points on this route are identified at the junction with Frankston-Flinders Road in Hastings and at the interchange with the South Gippsland Highway in Hampton Park.

The candidate sites for VMS installations are:

• on Western Port Highway, south of the roundabout at Frankston-Flinders Road in Hastings, to advise traffic to divert via Frankston-Flinders Road to head towards Melbourne in the event of any incidents on Western Port Highway.

• to the south of the South Gippsland Highway interchange, facing northbound traffic, to advise whether a more optimal route towards Melbourne is via the South Gippsland Freeway to the Monash Freeway or exiting to the South Gippsland Highway to access the Princes Highway through Dandenong.

**Dingley Arterial and Dandenong Bypass corridor**

A candidate site on the Dandenong Bypass has been identified to the east of Springvale Road, facing westbound traffic, to advise traffic to turn right and head north along Springvale Road in the event of an incident on Westall Road.

**Mornington Peninsula Freeway and Peninsula Link corridor**

The M11 Corridor incorporating the Mornington Peninsula Freeway and Peninsula Link is the most direct route between Melbourne and the Mornington Peninsula. Major decision points exist along this route at the northern end of the freeway in Bangholme, at the freeway interchange with EastLink in Carrum Downs, at the Moorooduc Highway interchange in Moorooduc and at the Nepean Highway interchange in Dromana.

The candidate sites for future VMS installations are described below:

• north of Nepean Highway interchange, facing southbound traffic in Dromana, to advise traffic of the need to divert along Point Nepean Road in the event of an incident along the section of the Mornington Peninsula Freeway through Dromana and Rosebud.

• south of the EastLink interchange, facing northbound traffic, to advise of the optimal route towards Melbourne either via EastLink or continuing along the Mornington Peninsula Freeway and Westall Road.

• north of the EastLink interchange, facing southbound traffic, to advise whether there is a need to divert onto the Frankston Freeway through Frankston in the event of an incident on Peninsula Link.

• south of Springvale Road at the northern end of the freeway to advise of the optimal route towards Melbourne, either via Springvale Road and Westall Road, Boundary Road and Clayton Road or Nepean Highway.

**Moorooduc Highway, Frankston Freeway and EastLink corridor**

The EastLink/Frankston Freeway (M3) corridor provides a north-south route through the eastern suburbs of Melbourne. Moorooduc Highway (C777 / C784) forms a southern extension of this route along the Mornington Peninsula running parallel to Peninsula Link.

The potential candidate sites for VMS at decision points along this route include:
• south of Hastings Road on Moorooduc Highway, facing northbound traffic, to advise of any incidents on the Frankston Freeway, Mornington Peninsula Freeway and EastLink and a benefit that may be obtained by diverting onto Hastings Road and Nepean Highway through Frankston or Dandenong-Frankston Road
• south of the EastLink interchange, facing northbound traffic, advising of any incidents ahead on either EastLink or Mornington Peninsula Freeway
• north of the EastLink interchange, facing southbound traffic, to advise of any incidents on Peninsula Link and whether motorists would benefit from continuing along the Frankston Freeway through Frankston
• South of the Princes Highway interchange, facing northbound traffic, to advise of any incidents on the Monash Freeway that would make it beneficial for traffic to divert to the Princes Highway to head towards Melbourne.

Springvale Road
Springvale Road is a major north-south arterial road that runs through the eastern suburbs of Melbourne. Candidate sites for VMS on this route include:
• north approach to the Mornington Peninsula Freeway, facing southbound traffic, to advise motorists in the event of any incidents on the Mornington Peninsula Freeway of the need to divert to Nepean Highway
• south approach to the Westall Road intersection, facing northbound traffic, to advise motorists of the need to continue north along Springvale Road in the event of any incidents along Westall Road.

Nepean Highway corridor
Nepean Highway is a significant arterial route which provides access between Melbourne and the Mornington Peninsula. Sections of this route parallel the Mornington Peninsula Freeway. There are also a number of significant north-south routes which provide connections between the Nepean Highway to the Monash Freeway or Princes Highway.
The candidate sites for VMS on this route include:
• south of Davey Street in Frankston, facing northbound traffic, to advise any incidents on the Frankston Freeway and encourage traffic to continue north along Nepean Highway through Frankston to head towards Melbourne
• south of Beach Road in Mordialloc, facing northbound traffic, to advise traffic to divert along Beach Road in the event of an incident along Nepean Highway to head towards Melbourne.
• south-east of Warrigal Road in Mentone, facing north-westbound traffic, to advise traffic to divert along Warrigal Road in the event of an incident along Nepean Highway to head towards Melbourne.
• south-east of Hawthorn Road in Brighton East, facing north-westbound traffic, to advise traffic to divert along Hawthorn Road in the event of an incident along Nepean Highway to head towards Melbourne.

M80 Ring Road
There is currently a good coverage of VMS located along the M80 Ring Road that has been installed as part of the M80 Ring Road Upgrade project. A candidate site for an additional VMS installation is to the south of the Deer Park Bypass, facing northbound traffic, to advise of any incidents on the bypass and to direct traffic to divert onto Ballarat Road.

VMS candidate site locations
Refer to Figure 14 and Figure 15 for the candidate VMS site locations.
Figure 14: Decision Points for VMS – Melbourne North and West
VicRoads approvals for candidate site locations

The information contained in this guideline is designed to assist practitioners in identifying potential high priority locations. Practitioners are encouraged to use the information contained in these guidelines to assist in supporting any finding submissions and necessary internal approvals. Any locations in this guideline can be considered as having Network Policy & Standards support. Approval to locations outside of those shown requires approval of the Director – Network Policy & Standards including justification as to how the proposed locations meet Decision Point Principles of Section 3.

5. Additional Information – Traffic Signals

Responsibilities for some specific treatments

The responsibility for traffic signals is aligned with the responsibility of the road. Municipal councils are generally responsible for sites involving only municipal roads; VicRoads is responsible for sites on arterial roads and at freeway interchanges.

In addition to the above, VicRoads is generally responsible for signal sites:

- within the Melbourne metropolitan area
- on a tram route where active tram priority is provided
- where connected and coordinated with train level crossing signals or emergency vehicle signals at fire or ambulance stations
- where the signals are adjacent to an arterial road and VicRoads control is considered necessary for the successful operation of the arterial road.

Signal maintenance on local roads may be undertaken by VicRoads at the request of a municipal council on a fee-for-service basis.


Traffic signal installations are Major Traffic Control Devices and require VicRoads' written authorisation for their alteration, installation, or removal. VicRoads' authorisation is subject to the presentation of satisfactory traffic signal layout designs. Traffic signal layout designs should be developed in accordance AGTM Parts 9 and 10, AS 1742.14 and any other design notes which may be issued by VicRoads.

Traffic control signals are Major Traffic Control Devices and are not delegated to municipal councils.

The Road Rules covering traffic signals are given in Part 6 of the Road Safety Road Rules 2009.

Under Section 16(1)(c) of the Transport Act 1983, a function of VicRoads is to "purchase, design, construct, erect, install, maintain and operate traffic signals and other traffic facilities for the purpose of traffic management and control".

Guidelines for new traffic signal installations

Traffic signals are predominantly used where other less expensive forms of treatment are found to be unsatisfactory operationally or have a high crash rate. Traffic signals involve not only an initial installation cost but also continuing maintenance costs.

Section 2.3.3 of AGTM Part 6 (2013) lists the intersecting road types where traffic signals may be appropriate.

Considerations for the installation of traffic signals

The traffic volumes given below are a guide for the consideration of traffic signals, however intersection analysis (e.g. using the latest version of 'SIDRA' software) should be used to determine the level of service of unsignalised and proposed signalised intersections. The road network and the actual operation of the roads should also be taken into account when considering traffic signals.

A detailed intersection analysis should be undertaken and a traffic assessment report of the various cases should be submitted to the local VicRoads Regional office demonstrating the need for traffic signals.
a) **Traffic volume**

Traffic signals may be considered subject to detailed analysis; when the major road carries at least 600 vehicles/hour (two way) and the minor road concurrently carries at least 200 vehicles/hour (one way) on one approach over any 4 hours of an average day.

Where the 85th percentile speed on the major road exceeds 80 km/h or in isolated communities of less than 10,000 population, the minimum vehicular volumes given above may be lowered to 420 and 140 vehicles per hour respectively.

Predicted and/or actual traffic volumes are considered with other factors such as directional flows, turning movements, conflict points, operating speeds and whether the major road is a divided or undivided road.

b) **Continuous traffic**

Where traffic on the major road is sufficient to cause undue delay or hazard for traffic on a minor road, traffic signals may be considered when the major road carries at least 900 vehicles/hour (two way) and the minor road concurrently carries at least 100 vehicles/hour (one way) on one approach, over any 4 hours of an average day.

However the signals should not be provided if an existing signalised intersection can be easily reached and has spare capacity, or if the traffic signal would disrupt the progressive flow of traffic on the major road, or if additional access points could be provided within a new subdivision.

c) **Pedestrians**

For further guidance regarding pedestrians at signalised intersections, refer to AS 1742.10.

d) **Crashes**

To reduce crashes, signals may be considered if there is an average of 5 or more reported casualty crashes over 5 years which may be eliminated or reduced by traffic signals and the traffic volume is at least 0.8 times the volume guidelines given above. Signals should only be installed if a simpler device will not effectively reduce the crash rate or a roundabout is not suitable.

Crashes which may be eliminated or reduced by the provision of traffic signals generally include only vehicle to vehicle right angle collisions, right turn against opposing flow and certain collisions involving pedestrians or cyclists (i.e. Definition for Classifying Accidents (DCA) codes 110 to 119 inclusive and 100, 101 and 102).

e) **Combined factors**

In exceptional cases, signals may occasionally be justified where no single guideline is satisfied but where two or more of the volume guidelines above are satisfied to the extent of 0.8 times or more of the stated value. Traffic signals should not be installed in 100 km/h speed zones.

f) **Within coordinated signal systems**

Traffic signals may be occasionally justified at intersections within or near a coordinated traffic signal system where operation of the intersection without traffic signals causes significant interference to the progression of traffic to or from nearby traffic signals. Such signals will be appropriate only where it is possible for them to be coordinated with nearby signals.

g) **Traffic management plans**

Traffic signals may occasionally be justified as forming an essential part of an overall traffic management plan for an area to promote use of the road network in accordance with the objectives of the plan. However, caution needs to be exercised that through traffic problems are not created on the local road network in the area. Other factors which may need to be taken into consideration include bus routes and principal bicycle routes in the area.

**Design process of traffic signals**

When designing traffic signals, two main processes are generally followed:

- the data collection process
- the data analysis process.
Data collection process

Information that must be gathered before designing a set of traffic signals is as follows:

a) Site information
   - all ground services within 20 m of the intersection on each approach (e.g. pits, stop valves, fire hydrants, etc.)
   - point of electricity supply, telephone pits and (existing) controller location
   - public lighting poles and lanterns, tramway poles, electricity poles, etc. If possible, height and location of overhead wires at the intersection
   - pram crossings within intersection area
   - parking poles, signs and type of restriction approximately 60 m along each approach or to end of restriction if possible
   - driveways approximately 60 m along each approach
   - kerb and channel type e.g. bluestone, concrete, etc.
   - height of verandas or awnings to underside and their thickness if possible
   - all existing detector loops, detector pits and conduit pits
   - nature strips, footpaths and trees - establish whether trees require pruning
   - all existing signals, lantern type and number, pedestal type, internally illuminated signs, pedestrian signals and push-buttons, audible pedestrian signals, etc.
   - photographs of the intersection from all approaches sufficient to give a drivers view which should show any obstructions or peculiarities, such as over-hanging trees, poles, etc.
   - if photographs do not show all linemarking, locate and establish type of linemarking, e.g. painted islands, double lines, continuity lines, lane lines, etc., by chainage and cross-section to tangent points, changes of direction and start and finish of such features.

b) Plan

A plan of the intersection or mid-block area at 1:250 scale is required. If no plan is available, a survey must be undertaken to determine:

   - the kerb and building lines
   - all above and below ground features including poles, service pits, trees, verandas, awnings, power lines, parking signs, side entry pits, pram crossings, overhead lighting, footpaths, bus and tram stops.

c) Traffic volume

A peak hour turning movement traffic count carried out for a minimum of two hours in both peak periods. This should include a count of pedestrians where appropriate.

d) Accident data

A collision diagram may be required showing all crashes in the intersection or mid-block area for a minimum of the previous five years.

e) Future developments

Information on any known or likely future developments in the surrounding area (e.g. shopping centre development, service relocations, road widening or realignment, major sporting complexes, etc).

f) Traffic management strategy

Information regarding the particular strategy to be adopted to manage the traffic, i.e. which movements should be encouraged, discouraged, banned or maintained, particularly public transport priorities.
Data analysis process

The data collected should be analysed in the following order:

a) Intersection/mid-block geometry

Initially the existing geometry should be checked to see that it conforms to current standards. Secondly the inclusion of medians, islands to create free left turn lanes and modified corner radii can improve the intersection definition, improve vehicle turning movements or slow down turning vehicles to improve pedestrian safety.

Narrowing of lanes or flaring into medians can provide additional through or turning lanes to improve intersection capacity.

Reducing the size of the intersection, particularly the ‘dead’ areas by kerb extensions, can substantially reduce pedestrian walk times.

b) Future developments

The requirements of any future developments must be determined or estimated to determine their impact on the intersection geometry or phasing or installation of the signals.

c) Crash analysis

An analysis of the collision diagram and if necessary the accident report forms shall be undertaken to determine if there are any geometric or special signal phases or other requirements such as linemarking or street lighting necessary to improve the level of safety.

d) Strategy

As there are a number of measures (i.e. geometric or signal phasing), available to encourage or discourage various movements, the most cost effective method must be determined.

e) Phasing and capacity analysis

Finally a draft geometric layout is determined and a capacity analysis is undertaken. An analysis of the phasing system should be conducted when taking into consideration the levels of saturation, cycle times, saturation flows, lane configurations and other variables.

For linked intersections, the design will need to be analysed using the maximum linked cycle time. The reason for using the linked cycle time is to ensure turn lanes are the appropriate length for maximising capacity under linked operation when all sites run the same cycle time.

Remodelling of intersection traffic signals

The need for remodelling of traffic signals may arise as a result of one or more of the following:

- changes in the volume distribution of traffic or pedestrians using the intersection (e.g. need for right turn phase)
- proposed roadworks
- the need for safety improvements
- the need to modernise the equipment
- the need for signal linking
- the need for public transport priority features.
Third party traffic signal & street lighting installations

All traffic signal and street lighting works generated or occasioned by parties other than VicRoads must be fully funded by the party that generated or occasioned the works.

Examples of such works include a municipal council narrowing a road, involving the relocation of a signal pedestal or a new set of traffic signals required as mitigating works for a development on adjacent or nearby land.

The relevant VicRoads Region has the responsibility for ensuring that there is a clear understanding, agreement and a commitment from the third party to pay full costs incurred by VicRoads. Where the works come about as a result of a Planning Permit application, the planning permit condition will require works to be done to the satisfaction of and at no cost to VicRoads. Where works are not the result of a Planning Permit Application the Region must ensure that funds have been made available prior to the issue of any formal consent for the works to commence.

When other third parties carry out works, it is preferable to inform these authorities that they must recover their own costs. Such situations should also have clear up front agreements covering matters such as responsibilities for costs involved with installation, design and maintenance.

The total maintenance cost over 10 years is calculated for:

- Intersections with SCATS
- Intersections without SCATS
- Pedestrian operated signals with SCATS
- Pedestrian operated signals without SCATS
- Pedestrian (zebra) crossings with flashing lights
- additional street lighting.

This calculation includes the electricity costs associated with the above installations.

Further details of the VicRoads policy, including the latest 10 year costs are available in the Statutory Planning - Operating Costs: Traffic Signals & Street Lighting policy located in Smartdocs, or by contacting the VicRoads Network and Land Use Policy team on tel: 9854 2920.

Specifying site works for traffic signal plans

Remodel notes on signal layout plans need to be clear to avoid any misrepresentation by signal installation contractors. With this in mind, the "Installation/Remodel Notes" have been standardised and should follow the format below. However, it is recognised that variations to these notes and additional notes may sometimes be required.

Designers need to know if the works are combined (i.e. single contractor) or separable parts (i.e. Signal Contractor, Works Contractor etc).

INSTALLATION / REMODEL NOTES
A. SIGNAL CONTRACTOR

NEW SITE
1. Supply and install new hardware as shown using LED lanterns.
2. Supply and install traffic signal mains supply/meter cabinet and connect to point of supply.
3. Supply and install additional detector pit and 1/20 conduit for Telstra connection.
5. Supply and install detector loop SB1 and NB1 as a 1m long, 6 turn loop, with 150mm clearance to lane line and/or lip of K&C.
TOTAL REMODELS
1. Supply and install new hardware as shown using LED lanterns.
2. Supply and install/replace traffic signal mains supply/meter cabinet and/or point of supply.
3. a. Remove all existing above-ground hardware and reinstate pavement/footpaths to superintendent’s satisfaction.*
b. Remove all existing P.O.S, pedestrian crossing, school crossing hardware on east, west approach and reinstate pavement/footpaths to superintendent’s satisfaction.
* Liaise with the VicRoads Road Operations traffic signal maintenance section to determine where the redundant hardware should be returned to.
(See “additional notes” for further notes required).

PARTIAL REMODELS
1. PEDESTAL n
   - Install pedestal base and relocate existing 2A, 2B, JUP, JUMA, MA from redundant pedestal En as shown.
   - Install new 2A, 2B, JUP, JUMA, MA as shown.
   - Install new 3-aspect, X, Z QH/LED lantern as shown.
   - Remove existing 3-aspect, 5-aspect, X, Z lantern as shown.
   - Replace/Retrofit 3-aspect, 5-aspect, X lantern with new X, S QH/LED lantern as shown.
   - Relocate 3-aspect, X, Z lantern from redundant pedestal En as shown.
   - Replace existing QH lanterns with new LED lanterns including pedestrian lanterns.
2. Pedestal n (Repeat above applicable notes for all pedestals altered)
3. Remove all redundant above-ground hardware.*
4. Remove all redundant above-ground hardware and liaise with the VicRoads Road Operations traffic signal maintenance section to determine where the hardware should be returned to.
5. Install audio tactile pedestrian detectors constant or variable output.
6. Install/replace mains isolation box/meter box at point of supply.
7. a. Install 1/20/50/100 conduit, n conduit pits, new controller base and n detector pits as shown.
b. Install 1/50/100 conduit, n conduit pits and extend existing conduit location to suit new conduit pit location.
   c. Install 1/20 conduit to Telstra pit as shown.
   d. Expose sand and slab adjacent to pedestal n, and extend existing conduits to new conduit pits.
   e. Remove redundant conduit pit location and extend existing conduit to suit new conduit pit location.
   f. Supply and install additional detector pit and 1/20 conduit for Telstra connection.
8. Convert existing conduit pit location into heavy duty conduit pit with heavy duty lid.
9. Install n detector pits on direction approach and 1/50 conduit to conduit pit.
10. Install detector loops E1, E2, E(6) as shown and associated feeder cables.
11. Install loops E1, E2, E(6) as shown and install detector loop cables in individual saw cuts along the edge of kerb and channel to new detector pit.
12. Re-cut loops E1, E2, E(6) and connect to new detector pit.
13. Supply and install detector loop SB1 and NB1 as a 1m long, 6 turn loop, with 150mm clearance to lane line and/or lip of K&C.

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14. Re-cable site as required.
15. a. Contractor to supply all the above hardware using QH/LED lanterns.
   b. Contractor to supply all the above hardware using QH/LED lanterns

* Liaise with Metro North West Regions signal maintenance section to determine where the redundant hardware should be returned to.
(See “additional notes” for further notes required).

ADDITIONAL NOTES
1. Construct new controller base for new controller location.
2. PEDESTAL n
   - Install vertical louvers on direction facing green circle aspect.
   - Direction facing lanterns to be cross aimed and tilted to restrict visibility to traffic approaching from the direction.
3. Install 1 no. Puffin Walk Detector, on pedestals n & n.
4. Install 10 pair communications cable as shown, from controller to fire station/ambulance/train operator communication room/railway level crossing controller.
5. Reuse audio tactile pedestrian directors constant or variable output.
6. Additional cabling (approximately n m) to be placed in pit near pedestal n to provide for relocation of pedestals due to future road widening.
7. Contractor to seal veranda roof / ceiling at pedestal n. Reinstated area to be completed to the satisfaction of the superintendent.
8. Cut pedestal n to suit veranda height, cap and install pedestal n under veranda and fit junction box.
9. Provide for advance tram detection, (including detector pits, 1/50 conduit, conduit bend & galvanized pipe) see General Notes n.
10. Install bases and 1/100 conduit for photo-violation camera and flash unit.
11. Relocate photo-violation camera and flash unit as shown.
12. Install 1/100 Public Lighting conduit as shown.
13. Install additional detector pit and associated 1/20 conduit on location for Telstra connection.
14. The pedestals for the direction approach need to be located so that they satisfy the requirements of Metro / V/Line focussing diagrams for the level crossing.
15. Pedestal n – Supply and install required equipment to allow radio connection between fire/ambulance station and traffic signal controller detector inputs (2 push buttons) and output (call acknowledge lamp)
16. Supply and install emergency signal control panel in fire/ambulance station as shown including:
   - Call push button
   - Cancel button
   - Call received button
17. Connect buttons and call acknowledge lamp in fire/ambulance station to radio link equipment on roof of fire/ambulance station.
18. Modify controller for detector inputs from radio link.
19. Modify controller for call acknowledge lamp.
B. COUNCIL/ROADWORKS CONTRACTOR **
1. Construct roadworks as shown.
2. Construct n DDA compliant pram crossings in accordance with AS 1428.
3. Construct n cut-through walkway as shown in accordance with AS 1428.
4. Reinstate kerb at n pram crossings as shown.
5. Supply and installation of public lighting and/or the removal of any redundant poles or equipment. See General Notes
6. Trim/remove trees as shown to suit roadworks/to provide required sight distance to traffic signals.
7. Construct (supply all materials and labour) pedestrian footpath as shown.
8. Construct (supply all materials and labour) pedestrian fencing as shown.
9. Supply and install temporary kerbing as shown.
10. Supply and install parking sign pole and/or face at P1, P2, P3
11. Remove parking sign pole and/or face at R1, R2
12. Replace parking sign face at P1, P2
13. Relocate parking sign face from R1 to P1.
14. Relocate parking sign face from R1, R2 to P1, P2 respectively.
15. a. Linemark as shown and remove any redundant markings.
   b. Repaint linemarking.
16. Supply and install R.R.P.M.’s and R.P.M.’s as shown and remove any redundant markers.
17. Supply and install road signs where shown and remove redundant signs.
18. All VESI pits and associated conduits to be installed by power company approved pre-qualified electrical contractors.

C. VICROADS
(i) REGION **
1. a. Supply and install new controller.
   b. Supply and install new LED compatible controller. (Dimming enabled)
C. Remove existing controller and supply and install new controller on existing controller base. (Note: It is advisable that Roadside & Electrical Operations section confirm whether the existing base will adequately accommodate the new controller).
2. Supply JUP, JUMA, MA for pedestal n as shown.
3. Supply and install new PROM.
4. Upgrade controller software to V5 Release 82. (Relevant to PSC controllers only)
5. Modify controller for additional detector loop.
6. a. Supply and install n no. 4 group lamp load module and n no. group terminal strip.
   b. Supply and install n no. 4 group LED lamp load module and light sensor.
† Note: The number (n) of lamp load module(s) required for each of the following controller types as follows:

(All notes that require the contractor to supply and install hardware are to be located above the note “Contractor to supply all the above hardware.”)
PSC/ATSC4/QTC – 4 group lamp load modules / 4 group terminal strip. (e.g. An additional 6 signal groups will require 2 no. 4 group lamp load module and terminal strips fitted)

Alpha16/Eclipse – 8 group lamp load modules / 4 group terminal strip. (e.g. An additional 6 signal groups will require 1 no. 8 group lamp load module and 2 no. terminal strips fitted)

7. Arrange for the installation of a Telstra distribution pit over the detector pit containing the 1/20 conduit and connect to SCATS.

8. Terminate communication cable as shown from controller to fire station, ambulance, rail.

9. Construct roadworks as shown.

10. Construct n DDA compliant pram crossings as per AS 1428.

11. Reinstate kerb at n pram crossings as shown.

12. a. Linemark as shown and remove any redundant markings.

   b. Repaint linemarking.

13. Install RRPMs and RPMs as shown and remove any redundant markers.


15. Install road signs where shown and remove redundant signs.

** These modifications can be arranged by other business areas including SmartBus, Think Tram, Rural VicRoads Regions, Major Projects (e.g. M80). Substitute the appropriate business area name on the remodel/installation notes as required.

(ii) REGION **

1. Connect controller to SCATS.

1. Connect controller to SCATS via 3G modem.

1. Connect controller to SCATS Dial in/Dial out.

(iii) ROAD OPERATIONS – EAST/WEST

a. Program new controller

b. Reprogram controller for modified phasing.

D. YARRA TRAMS

1. Supply and install overhead detector cable on east and west approaches.

2. Supply and install safety zones as shown.

3. Supply and install tram stopping studs.

4. Relocate tram poles as shown.

5. Relocate/remove /install tram stops/shelters as shown.
OTHER NOTES WHICH MAY BE REQUIRED ON THE PLAN

A. The following notes, as appropriate, are to be placed in the notes section.

Base information obtained from...........

Declared Road – Name (Speed zone n km/h), Local Road – Name (Speed zone n km/h)

Declared Road – Name (Speed zone 40 km/h 8.00am-10.00pm Mon-Sun/60km/h), Local Road – Name (Speed zone n km/h)

Advance tram detection on:-
(i) North approach - pit to base of tram pole n (m), detector cable overhead to n pole
(ii) South approach - pit to base of tram pole n (m), detector cable overhead to n pole

Or
(i) North approach - use transfer of demand from the intersection of location (n m).
(ii) South approach - use transfer of demand from POS location (n m).

Audio tactile pedestrian detectors installed.

Emergency Vehicle Receiver installed on pedestal n.

Public lighting notes,
(i) Pedestal n to be n m JUP, JUMA, JUEP, JUELP, JUTP, mounting height n m, outreach n m, with 150 W, 250 W HPS luminaire.
(ii) Pole on corner of location to be n m JUEP, JUELP, JUTP, mounting height n m, with 150 W, 250 W HPS luminaire.
(iii) Tram Operator pole no n to be JUTP, mounting height n m, outreach n m, with 150 W, 250 W HPS luminaire.
(iv) Pole A to be impact absorbing pole, mounting height n m, outreach n m, with 150 W, 250 W HPS luminaire.

B. The following notes are to be placed near phasing diagrams.

Tram priority phases not shown.

For full phasing details refer to controller operation sheets.

Show turn bans and times:
e.g. NRT S-E 4:30PM-6:30PM MON-FRI.

Show part time full control details:
e.g. Full control arrow for south to east right turn to operate at all times except 7.00AM – 9.00AM (and 4.00PM – 6.00PM) MON – FRI. During this period red arrow is blanked/drops in phase n.

Show details of partially controlled right turns with conditional red:
e.g. *Red arrow drops in phase n.

C. The following note to be placed under plan number.

1. Supersedes plan no. n

Display of signs on plans

Signs and their standard identification numbering should be shown on the signal layout plan.

For information regarding typical signing layout for various intersection types refer to AS 1742.2 and AS 1742.15 and their relevant VicRoads supplements.

If a sign is existing it will be shown for example as (E) and proposed signs are indicated on a sign schedule.
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Manager – Network Standards

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Previous versions of this document are available on request by contacting the VicRoads – Network Standards team.

For enquiries regarding this supplement, please contact the VicRoads – Network Standards team via tem@roads.vic.gov.au or 9854 2417.