

Technical Specification

**Transport and Main Roads Specifications
MRTS206 Provision of Variable Speed Limit and
Lane Use Management Signs**

July 2025



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1 Introduction

This Technical Specification accepts Section 1.1 *Scope of AS 5156:2020 Electronic speed limit signs* with deletion of ‘This standard does not cover the lane use management signs.’

This Technical Specification also defines the testing and commissioning, documentation, training, maintenance and handover requirements for Variable Speed Limit Signs (VSLS), Variable Speed Limit and Lane Use Management Signs (LUMS) and associated group controllers.

This Technical Specification accepts Section 1.2 *Application of AS 5156*. These signs may be used as part of an overall traffic management system to detect, monitor, manage and control traffic on the road network by altering the posted speed limit and/or lane use management status through a defined zone.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements*, MRTS201 *General Equipment Requirements* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

2 Definition of terms

This Technical Specification accepts Section 1.4 *Definitions* of AS 5156 and the terms defined in MRTS201 *General Equipment Requirements*. Additional terminology relevant under this Technical Specification are defined in Table 2.

Table 2 – Definitions

Term	Definition
ACMA	Australian Communication and Media Authority
Administrator	Refer to definition in MRTS201 <i>General Equipment Requirements</i>
Default speed	The speed limit that applies to a location in a variable speed limit zone when all the VSLS or VSLS / LUMS are blank (also known as ‘black-out speed’)
Event	Sign status change, frame change, occurrence of a fault in group controller or sign
ESL	Electronic Speed Limit Signs (includes the VSLS / LUMS)
Field Processor (FP)	An industrial computer complying with requirements of MRTS232 <i>Provision of Field Processors</i>
Frame	Any stable state displayed by a VSLS and/or VSLS / LUMS on its display at any one instance of time that is preceded and followed by a change of state.
GNSS	Global Navigation Satellite System
Group controller	A local control unit providing the operational interface to one or more physically connected signs.
MTBF	Mean Time Between Failures
NATA	National Association of Testing Authorities
NTP	Network Time Protocol
PFC	Permissible frame combinations: frame combinations at each VSLS location that facilitate safe, non-conflicting traffic movement in a VSLS zone (selection of permissible frames at a VSLS site is also known as local interlocking)

Term	Definition
PHCS	Product Host Control System
PTN	Principal's Telecommunications Network
RCM	Regulatory Compliance Mark
RPEQ	Registered Professional Engineer of Queensland
ROAR	Road Operations Asset Register
Sign	VLSL and/or VLSL / LUMS
Sign group	A group of signs that face the same way in the roadway and are connected to the same group controller (also known as a 'VLSL site'). The displays shown by signs in a group need not be of the same frame at any one point in time
SIMS	STREAMS incident management system
STREAMS	The Principal's Traffic Management System (TMS) and primary user interface to ITS field devices
TMC	Traffic Management Centre
TMS	Traffic Management System
VLSL Site	Includes sites with VLSL / LUMS. Refer also to sign group
VLSL / LUMS	Combination Variable speed limit / Lane use management sign(s) – used to display variable speeds (type of Electronic Speed Limit Sign), as well as lane use symbols; typically overhead mounted
VLSL	Variable speed limit sign(s) – used to display variable speeds only, typically pole-mounted

3 Reference documents

This Technical Specification accepts Section 1.3 *Normative References* of AS 5156.

The requirements of the referenced documents listed in Table 3 of MRTS201 *General Equipment Requirements* and Table 3 below apply to this Technical Specification. Where there are inconsistencies between this Technical Specification and referenced Technical Specification documents, the requirements specified in this Technical Specification take precedence.

Table 3 – Referenced documents

Reference	Title
AGTM 10	<i>Austrroads Guide to Traffic Management – Part 10 – Transport Control – Types of Devices</i>
AS 5156	<i>Electronic speed limit signs</i>
AS/NZS 3000	<i>Electrical installations (Wiring Rules)</i>
AS/NZS 3190	<i>Approval and test specification – Residual current devices (current-operated earth-leakage devices)</i>
ISO 9001	<i>Quality management systems – Requirements</i>
MRTS01	<i>Introduction to Technical Specifications</i>
MRTS50	<i>Specific Quality System Requirements</i>
MRTS61	<i>Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices</i>
MRTS71	<i>Reinforcing Steel</i>

Reference	Title
MRTS78	<i>Fabrication of Structural Steelwork</i>
MRTS91	<i>Conduits and Pits</i>
MRTS200	<i>General Requirements for Intelligent Transport Systems (ITS) Infrastructure</i>
MRTS201	<i>General Equipment Requirements</i>
MRTS210	<i>Provision of Mains Power</i>
MRTS226	<i>Telecommunication Field Cabinets</i>
MRTS232	<i>Provision of Field Processors</i>
MRTS263	<i>Standalone Solar (PV) Power Systems</i>
MUTCD	<i>Queensland Manual of Uniform Traffic Control Devices</i>
QGTM Part 10	<i>Queensland Guide to Traffic Management Part 10</i>
TC1785_1&2	<i>Variable Speed Limit Sign LED display – Square / Rectangle</i>
TS 03644 (formerly TSI-SP-003/TfNSW)	<i>Communications Protocol for Roadside Devices</i>
VSL Concept of Operations	Transport and Main Roads <i>Variable Speed Limit System Requirements, Design Criteria and Concept of Operations Document</i>

4 Quality system requirements

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications*.

The quality system requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. In addition to MRTS20 *Cutback Bitumen* requirements, the Hold Points, Witness Points and Milestones applicable to this Technical Specification are summarised in Table 4.

Table 4 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
4.1	1. Samples for acceptance (design) 2. Optical performance certification 3. Test certificate		
6.6	4. Location of mounting structure 5. Mounting structure compliance to MRTS78 <i>Fabrication of Structural Steelwork</i>		
11.1			Submission of civil works design documentation
11.3.2		1. Optical performance test certificate	
11.3.2		2. Factory Acceptance Test	

4.1 Samples for acceptance

In addition to the requirements of Clause 4.2.1 of MRTS201 *General Equipment Requirements*, the following requirements also apply to this Technical Specification. Detailed designs of the sign layout, fabrication and assembly drawings, calculations, Technical Specifications, and certifications of the VLSL and/or VLSL / LUMS components (signed by the Contractor's RPEQ) must be submitted to the Principal via the Administrator for verification prior to manufacture. These components include the group controller, sign face, LEDs, LED matrix boards, pixel arrangements showing horizontal and vertical pitch and total number of pixels, power supply, communication ports, cable termination, enclosure, and mounting accessories. **Hold Point 1**

Optical performance test methodology and NATA certification confirming the VLSL / LUMS performance requirements specified in this Technical Specification must be submitted before delivery to site. **Hold Point 2**

A test certificate shall be provided to confirm the ingress protection level of the sign enclosure. The certification shall be issued by a NATA accredited test facility. **Hold Point 3**

5 General design and arrangement

5.1 General

This Technical Specification accepts Section 2.1 *General* of AS 5156 with the following amendments:

Delete

'The construction and layout of the sign enclosure, framework and internal components shall allow insitu removal and reinstatement of pixel modules.'

Add

'The mechanical and physical requirement defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.'

5.2 Design life

This Technical Specification accepts Section 2.2 *Design life* of AS 5156.

5.3 Markings and labels

This Technical Specification accepts Section 2.3 *Markings and labels* of AS 5156.

6 Mechanical requirements

6.1 Sign enclosure

This Technical Specification accepts Section 3.1 *Sign enclosure* of AS 5156 with the following amendments:

Delete

Lockable, left or right-hinged door(s) on the front or rear of the enclosure, as specified by the purchaser, to allow access to the internal components of the sign. Each door shall be provided with UV-stable closed-cell door seals and fitted with fastener(s) operated by a security key approved by the sign purchaser. Door stays shall be provided to secure the doors in the open position.

Add

The sign enclosure shall be fully sealed, and access doors shall not be provided on the sign enclosure since there are no requirements for the sign to be field serviceable.

6.2 Sign mounting facilities

This Technical Specification accepts Section 3.2 *Sign mounting facilities* of AS 5156 with the following amendments:

Delete

'The sign shall be designed for rear mounting, bottom mounting or mounting as specified by the purchaser'.

Add

The sign assembly shall have mounting base and sign enclosure.

The mounting base shall be designed for rear mounting, bottom mounting or mounting as specified in the contract.

The attachment of the sign enclosure to the mounting base shall be through a quick release type to facilitate the mounting and unmounting of the sign enclosure completed within five minutes by a single person.

The sign enclosure shall have a restraining mechanism to prevent the sign enclosure being removed from the base and striking oncoming traffic in the event of sign mounting structure being hit by a vehicle.

The installation requirement defined in MRTS201 *General Equipment Requirements* applies to this Technical Specification.

6.3 Roadside cabinet

This Technical Specification accepts Section 3.3 *Roadside cabinet* of AS 5156 with the following addition:

Add

All equipment associated with the group controller must be installed in a suitable roadside enclosure that complies with MRTS226 *Telecommunication Field Cabinets* installed:

- as a ground mounted cabinet
- as an integral enclosure installed on the mounting structure (VSL / LUMS only), or
- in the case of tunnels, in a stainless steel or marine grade aluminium field cabinet mounted in accordance with the design documentation.

Pits and conduit must be installed in accordance with MRTS91 *Conduits and Pits* to provide cable access from the sign to the cabinet.

6.3.1 Application

Roadside cabinets conforming to MRTS226 *Telecommunications Field Cabinets* shall be provided for housing the group controller.

6.3.2 Construction and finish

This Technical Specification **does not** accept Section 3.3.2 *Construction and finish* of AS 5156. The surface finish requirements in MRTS226 *Telecommunications Field Cabinets* apply to roadside cabinets used in this Technical Specification.

6.3.3 Access doors

This Technical Specification accepts the intent of Section 3.3.3 *Access doors* of AS 5156. Detailed requirement for access doors shall be in accordance with MRTS226 *Telecommunications Field Cabinets*.

6.3.4 Ventilation

This Technical Specification accepts the intent of Section 3.3.4 *Ventilation* of AS 5156 and the detailed specification for roadside cabinet ventilation specified in MRTS226 *Telecommunications Field Cabinets*.

6.3.5 Protection against vandalism

This Technical Specification accepts the intent of Section 3.3.5 *Protection against vandalism* of AS 5156. However, detailed requirements for protection against vandalism shall be in accordance with MRTS226 *Telecommunications Field Cabinets*.

6.3.6 Contents

This Technical Specification accepts Section 3.3.6 *Contents* of AS 5156 with following amendments:

Delete

- Backup batteries
- where specified facility switch for 4 four operational positions, and
- A double socket-outlet complete with a 30-mA type II residual current device conforming to AS/NZS 3190. The socket-outlet shall be supplied and protected by a dedicated circuit breaker in the main switchboard.

Add

All the minimum set of accessories defined in MRTS226 *Telecommunications Field Cabinets*.

6.4 Facility switch

This Technical Specification **does not** accept Section 3.4 *Facility switch* of AS 5156. **This section does not apply in Queensland.**

6.5 Front cover retention method

This Technical Specification provides the following new Queensland specific information:

The front cover retention and seal design must allow for thermal expansion properties of the front cover material. The front cover surrounding framework and cover strips must provide the required weather proofing and strength for both positive and negative wind pressures, and, where applicable, tunnel deluge systems.

6.6 Mounting structure

This Technical Specification provides the following new Queensland specific information:

Each VSLS must be capable of being pole-mounted in the verge or on the concrete barrier. Mounting on bridge / overpass structures shall be to the acceptance of the Principal.

Each VSLS / LUMS must be capable of being mounted centrally above each lane either on a cantilevered structure, a gantry or from a tunnel roof.

Where signs are mounted above a carriageway, the vertical clearance from the lowest surface of the sign and the associated mounting structure must be a minimum of 6.1 metres or as otherwise specified in the design requirements.

The location and type of mounting structure to be provided for each group controller, sign and/or each group of signs must be shown on the design documentation. Mounting arrangements must provide means to adjust the vertical and/or horizontal alignment of each sign during commissioning and subsequent maintenance activities. Sign mounting components must allow replacement of the sign within 5 minutes.

Final footing, support structure design and locations as shown in design documentation shall be submitted to the Principal's representative for acceptance before fabrication. **Hold Point 4**

The mounting structure must comply with requirements of MRTS201 *General Equipment Requirements*, MRTS61 *Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices*, MRTS71 *Reinforcing Steel* and MRTS78 *Fabrication of Structural Steelwork*. **Hold Point 5**

Particular attention needs to be given to the requirements in MRTS78 *Fabrication of Structural Steelwork* relating to the use of a registered fabricator when fabricating mounting structures for VSLS and VSLS / LUMS.

7 Electrical requirements for mains operated signs

7.1 Conforming to wiring Standards

This Technical Specification accepts Section 4.1 *Conformance to wiring Standards* of AS 5156 with the following addition:

The electrical requirements defined in Clause 10 of MRTS201 *General Equipment Requirements* apply to this Technical Specification.

7.2 Operating voltage

7.2.1 General

This Technical Specification accepts Section 4.2.1 *General* of AS 5156 with the following addition:

Add

Momentary voltage loss of 50-ms shall not have any effect on the sign display and/or group controller.

Signs shall have either:

- a) inbuilt power supplies and powered by mains power, or
- b) external switch mode power supplies that can be housed at a different location.

Sign design shall consider the selection of the best sign type as specified by the contract and/or depending on the site conditions. Designers shall refer to the *Road Planning and Design Manual (RPDM)* for details.

7.2.2 Battery backup

This Technical Specification **does not** accept Section 4.2.3 *Battery backup* of AS 5156. **This section does not apply in Queensland.**

7.2.3 Lightning protection

This Technical Specification accepts Section 4.2.3 *Lightning protection* of AS 5156.

7.2.4 Extra Low Voltage (ELV) Operation

This Technical Specification provides the following Queensland specific information:

Where specified in the contract, the sign shall provide an option for ELV operation, so that the voltage used for the cable between a mains-connected roadside cabinet and the sign displays is ELV as defined in AS/NZS 3000.

All ELV installations shall be in accordance with AS/NZS 3000.

Circuits and layout diagrams for the ELV operation shall be provided.

7.3 Solar power

This Technical Specification accepts the intent of Section 4.3 *Solar power* of AS 5156. However, the application shall be as specified below.

Add

Where specified in the contract, the sign shall be designed to operate on solar power and the requirements defined in MRTS263 *Standalone Solar (PV) Power Systems* shall apply to this Technical Specification.

7.4 Communication equipment

This Technical Specification accepts Section 4.4 *Communications equipment* of AS 5156.

7.5 Real-time clock

This Technical Specification accepts Section 4.5 *Real time clock* of AS 5156 with the following amendments:

Delete

'Sign'.

Add

'Group Controller'.

7.6 Electromagnetic compatibility (EMC)

7.6.1 Immunity

This Technical Specification accepts Section 4.6.1 *Immunity* of AS 5156 with the addition shown below.

7.6.2 Electromagnetic emissions

This Technical Specification accepts Section 4.6.2 *Electromagnetic emissions* of AS 5156 with the addition shown below.

Add

The Contractor shall either provide a declaration of conformity of the sign to the requirements of Section 7.6 of AS 5156 or provide a valid Regulatory Compliance Mark (RCM) as defined in AS/NZS 4417.2. Details of RCM compliance is provided by the Australian Communication and Media Authority (ACMA).

8 Display and optical requirement

8.1 Display requirements

8.1.1 General

8.1.1.1 Display characteristics

This Technical Specification accepts Section 5.1.1.1 *Display characteristics* of AS 5156 with the following addition.

Add:

The primary function of each sign will be to display a speed limit message as per the regulatory sign as defined by the Transport Operations (Road Use Management – Road Rules) Regulation 1999. The sign must comply with the speed restriction sign (R4-1 specified in the MUTCD), except:

- with illuminated white numerals within an illuminated red annulus on a matte black background as shown in Figure 5.1.1.1(a).

Where required, the sign shall be able to display a static red cross, flashing red cross and white arrows as shown in Figure 5.1.1.1(b). Each speed limit and white arrow symbol shall be stored as a bitmap in the group controller.

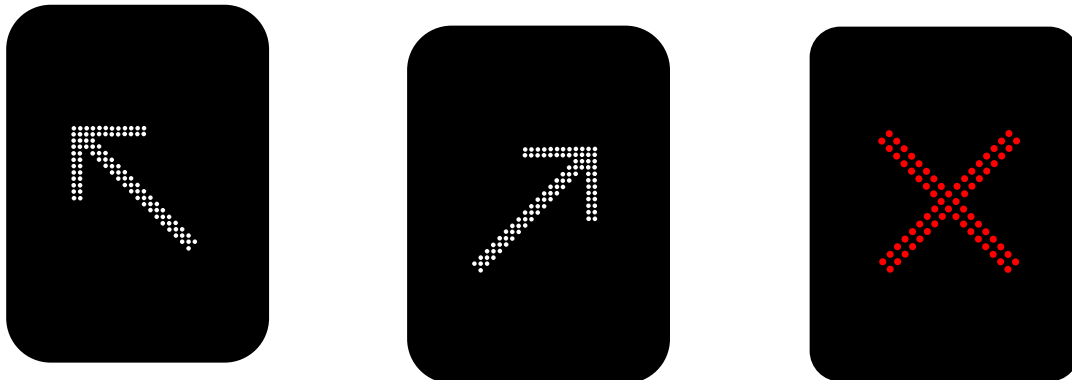
The display of numerals for speed regulation and information must comply as much as practicable with the fonts defined in MUTCD. Numerals must meet the fonts defined for use on a Regulatory Sign R4-1.

The sign numeric and/or arrow displays must be based on a series of pixels forming a dot matrix display system. The horizontal and vertical pitch of the pixels in the matrix must be the same. The Lane Closed 'X' and annulus display elements may be specifically arranged. The display must be physically capable of displaying speeds from 20 km/h up to the maximum speed for the VSL site in 10 km/h increments. The actual speed range for each site must be confirmed with the Principal during the commissioning activities and retained as part of the non-volatile information stored in the group controller. Only those frames permitted to be displayed at the site of installation shall be programmed into the group controller.

Figure 8.1.1.1(a) – Example speed limit



Figure 8.1.1.1(b) – Lane use symbols



8.1.1.2 Luminance output

This Technical Specification accepts Section 5.1.1.2 *Luminance output* of AS 5156.

8.1.1.3 Display colours

This Technical Specification accepts Section 5.1.1.3 *Display colours* of AS 5156 with the following amendments:

Delete

- Conspicuity device – yellow
- Other displays – user defined

8.1.1.4 Pixel service life

This Technical Specification accepts Section 5.1.1.4 *Pixel services life* of AS 5156.

8.1.1.5 Maintainability

This Technical Specification accepts Section 5.1.1.5 Maintainability of AS 5156 with the following differences:

Replace the first paragraph with the following

The sign shall be field replaceable within a short period of time by a single person. The sign shall be connected to the base through locking mechanism and cable connection that is easily released during the replacement.

8.1.2 Pixel arrangement

8.1.2.1 Pixel interspersion

This Technical Specification accepts Section 5.1.2.1 *Pixel interspersion* of AS 5156.

8.1.2.2 Annulus

This Technical Specification accepts Section 5.1.2.2 *Annulus* of AS 5156.

8.1.2.3 Numerals

This Technical Specification accepts Section 5.1.2.3 *Numerals* of AS 5156.

8.1.2.4 Pixel lit area

This Technical Specification accepts Section 5.1.2.4 *Pixel lit area* of AS 5156.

8.1.2.5 Discrete numeral signs

This Technical Specification accepts Section 5.1.2.5 *Discrete numeral signs* of AS 5156.

8.1.2.6 Annulus display

This Technical Specification accepts Section 5.1.2.6 *Annulus display* of AS 5156

8.1.3 Synchronisation of numeric display changes

This Technical Specification accepts Section 5.1.3 *Synchronisation of numeric displays* of AS 5156 with the following amendments:

Delete

- Master / Slave arrangement
- GNSS timing, and
- NTP time server.

8.1.4 Display changes due to facility switch operation

This Technical Specification **does not** accept Section 5.1.4 *Display changes due to facility switch operation* of AS 5156. **This section does not apply in Queensland.**

8.1.5 Display changes due to external inputs

This Technical Specification **does not** accept Section 5.1.5 *Display changes due to external inputs* of AS 5156. **This section does not apply in Queensland.**

8.1.6 Sign dimming control

8.1.6.1 General

This Technical Specification accepts Section 5.1.6.1 *General* of AS 5156 with the following addition:

Where a sign within a group of signs connected to a same group controller cannot be dimmed due to a faulty light sensing device, the group controller shall use the target dimming level of other working sign or average of target dimming level of all working signs of the group as the target dimming level of that sign.

8.1.6.2 Monitoring of automatic dimming control

This Technical Specification accepts Section 5.1.6.2 *Monitoring of automatic dimming control* of AS 5156.

8.1.6.3 Time-based dimming control

This Technical Specification accepts Section 5.1.6.3 *Time-based dimming control* of AS 5156.

8.1.6.4 Fixed dimming control

This Technical Specification accepts Section 5.1.6.4 *Fixed dimming control* of AS 5156.

8.1.7 Conspicuity devices

This Technical Specification **does not** accept Section 5.1.7 *Conspicuity devices* of AS 5156. **This section does not apply in Queensland.**

8.1.8 Display flicker

This Technical Specification accepts Section 5.18 *Display flicker* of AS 5156.

8.1.9 Character formats

This Technical Specification provides the following Queensland specific information:

The minimum legibility (sight) distance and character height must be as indicated in Table 8.1.9 for both daytime and night-time viewing.

Table 8.1.9 – Text and numeric display characteristics

MUTCD VLSL and/or VLSL/LUMS type	Regulatory sign size	Minimum sight distance (m)
*Type A – Square	450 mm (h) x 450 mm (d)	100
A	R4-1A	100
B	R4-1B	200
C	R4-1C	300
D	R4-1D	400

*Only to be used in tunnels where size constraints prohibit the use of Type B, refer to drawing TC1785_1&2

8.1.10 Red Cross display

This Technical Specification provides the following Queensland specific information:

The lane closed display consisting of a red cross must be configured in accordance with Table 8.1.10 *Lane use management display characteristics*.

Table 8.1.10 – Lane use management display characteristics

MUTCD VSLs / LUMS type	Minimum stroke width (number of pixels)
*Type A – Square	2
A	2
B	3
C	3
D	4

*Only to be used in tunnels where size constraints prohibit the use of Type B, refer to drawing TC1785_1&2

8.1.11 White arrow displays

This Technical Specification provides the following Queensland specific information:

The additional white arrow displays must be configured in accordance with Table 8.1.10 *Lane use management display characteristics*.

8.2 Optical requirements

8.2.1 Luminance and luminance ratio

This Technical Specification accepts Section 5.2.1 *Luminance and luminance ratio* of AS 5156.

8.2.2 Luminance matching of colours

This Technical Specification accepts Section 5.2.2 *Luminance matching of colours* of AS 5156.

8.2.3 Luminous intensity uniformity

This Technical Specification accepts Section 5.2.3 *Luminous intensity uniformity* of AS 5156.

8.2.4 Colours

This Technical Specification accepts Section 5.2.4 *Colours* of AS 5156.

8.2.5 Flashing annulus

This Technical Specification accepts Section 5.2.5 *Flashing annulus* of AS 5156.

8.3 Sun phantom

This Technical Specification provides the following Queensland specific information:

The effect of sunlight or other light sources shining on the optical elements must be controlled so that inactive pixels do not appear active.

9 Operation and control

9.1 General

This Technical Specification accepts Section 6.1 *General* of AS 5156 with the following amendments:

Delete

- External switch input
- Time based schedule, and
- (iv) Operation of conspicuity devices.

NOTE: A USB or Ethernet interface option may also be provided.

Add

The signs shall be operational by the Principal's Traffic Management System STREAMS.

The group controller shall allow two modes of operation as follows:

- LOCAL: stand-alone operation; TMS control disabled; TMS monitoring possible
 - MAINTENANCE: configuration / manual control while connected to PHCS, and
- REMOTE: normal operation; controlled from TMS.

The selected mode shall be reported by the group controller to the TMS.

This Technical Specification is limited to the functionality relating to:

- i) Group controller and signs at each VSLS / LUMS site. The group controller and associated signs form part of a broader TMS. The breakdown of the functionality of the components of this system and functional allocation between the TMS and group controller is described in Appendix C of this Technical Specification. Responsibility of the functionality ascribed to the Traffic Management System (TMS) is by others, and
- ii) Interface (device driver) and physical connection of the group controller to the TMS / Field processor.

9.2 Local control

This Technical Specification accepts Section 6.2 *Local control* of AS 5156 with the following addition:

The VSLS / LUMS shall generally be managed from the Traffic Management Centre (TMC) in accordance with the department's Concept of Operations of VSLS / LUMS via the TMS. In normal operation, a group controller shall provide the operational interface of the signs with the Principal's TMS. Connection of the group controller to the TMS shall be via an FP. In certain situations, the group controller may be required to operate independently of TMS.

Ramp and mainline sign groups shall each be provided with a separate group controller.

Requirements relating to the Product Host Control System (PHCS) are as follows:

- a) A PHCS shall be supplied with the group controller and signs for the group controller, sign configuration, commissioning and maintenance activities. The PHCS shall also allow setting of the group controller mode of operation.
- b) The PHCS must fully implement all group controller and sign functions as required by Clause 9.11 for each of the maintenance communications and control communications ports.

- c) The PHCS shall be configured to request passwords as part of the group controller access and configuration authorisation process.
- d) The PHCS shall be hosted on a Microsoft Windows® operating system environment from Windows 7 (or later) to those industry standards current at the time of use. Any software provided must be capable of operating on all such operating systems.
- e) The PHCS must be able to present to the user a graphic image of the group controller and the signs connected to it with icons or features that indicate whether there are any alarms or faults on any of the devices.
- f) The software must prompt the user to confirm a change to the group controller's mode of operation, and
- g) The PHCS shall be capable of suggesting ranges for each parameter as applicable when programming and not allow these limits to be exceeded. The PHCS shall allow batch processing of group controller configuration to the signs at respective VLSL site.

The hardware handshaking lines of the RS-232 interface shall be used so that connection / disconnection of the maintenance PC (either locally or by modem) results in the immediate initiation / termination respectively of the maintenance port communications session with the group controller.

A 100 / 1000Base-T Ethernet port(s) shall be provided in addition to RS-232 port in group controller for remote maintenance of the sign through a webserver running in the group controller. Webserver shall support secure connection through encryption of data using industry accepted protocol such as HTTPS. IP settings shall be configurable via the PHCS and the default IP settings shall be given in the product documentation.

When the PHCS is connected and operating, the group controller shall automatically change to 'MAINTENANCE' mode and blank all signs. The PHCS operator must enter an electronic password to select desired 'LOCAL' / 'REMOTE' operation, change the group controller configuration and/or sign displays. Once the PHCS operator has successfully logged on, the signs shall remain blanked unless specifically requested through the PHCS. Sign displays must comply with the respective PFC in all modes of operation.

While the PHCS is connected to the group controller, control of the group controller via the control port must be inhibited. However, status and diagnostic interrogation by the TMS via the control port must remain possible.

Where the group controller is selected (or reverts) to 'LOCAL mode', then the signs shall display the required frames. Where the group controller is selected (or reverts) to 'REMOTE' mode, the signs shall remain blank until the TMS commands otherwise.

Upon restoration of power after a power loss and/or reset, the group controller shall revert to the mode to which it was previously selected.

If the group controller is in the 'MAINTENANCE' mode, disconnection of the PHCS must not require further interaction from the user, nor in anyway interrupt operation or require rebooting of the group controller.

Upon disconnection of the PHCS, the group controller shall blank all signs and revert to the previously selected mode of operation, unless a different mode had been selected during the PHCS session.

9.3 Remote control

This Technical Specification accepts Section 6.3 *Remote control* of AS 5156 with the following addition:

The control communications port shall also support RS422 for local connection of a field processor / modem for communication with the TMS.

Two secondary communications ports that supports RS422 and 100 / 1000Base-T Ethernet for local connection of a field processor / modem for communication with the TMS shall also be provided. This port may be used in the event of failure of the primary communications port.

The group controller communications software must be capable of operating at all possible modem connection and/or serial port speeds.

Table 9.3 – Details of the Communication, Control and Maintenance Ports

Equipment	Port name	Specification	Function
Group Controller	Maintenance communications port	RS-232	Maintenance access to group controller and signs
Group Controller	Maintenance communications port	100 / 1000Base-T	Auxiliary Maintenance Ethernet port
Group Controller	Primary control communications port	RS-422	Control and communication with STREAMS via FP
Group Controller	Secondary control communications port	RS-422	Control and communication with STREAMS via FP & PHCS
Group Controller	Secondary control communications port	100 / 1000Base-T	Control and communication with STREAMS via FP & PHCS
Group Controller	Sign control communications port	RS-422	Control and communication with sign
Sign	Sign control communications port	RS-422	Control and communication with group controller
Sign	Sign maintenance communications port	RS-232	Maintenance access to sign

9.4 Programming

This Technical Specification accepts Section 6.4 *Programming* of AS 5156 with the following amendments:

Delete

‘All signs shall be capable of operating via scheduled events for particular times, such as weekends, public holidays, school holidays, special events and daylight saving.’

Add

'Unless otherwise advised by the Principal, the group controller and sign shall be programmed with the factory defaults shown in Appendix D.'

9.5 Communications protocol

This Technical Specification accepts Section 6.5 *Communications protocol* of AS 5156 with the following addition:

Add

Communication between the field processor and the group controller shall comply with TS03644 (formerly TSI-SP-003 or other protocol accepted by the Principal's Representative and the requirements of MRTS201 *General Equipment Requirements*.

The group controller must have session management ability to protect the system against unauthorised access via the communications ports.

9.6 Monitoring, fault logging and reporting

This Technical Specification accepts Section 6.6 *Monitoring, fault logging and reporting* of AS 5156 with the following amendments:

Delete

- The status of the conspicuity devices at the sign (on, off or faulty), and
- The status of the backup batteries (where fitted).

The fault log shall accommodate not less than 20 entries.

Add

The group controller shall monitor and log the high sign enclosure temperature.

The group controller shall log in non-volatile memory all operational and fault events having not less than 255 entries each for operational events and fault events.

The sign and group controller must each monitor the state of its respective processor and blank the respective display(s) if processor failure occurs. The group controller shall generate an alarm and blank all signs (including lane use symbols) if the integrity of the firmware or configuration is breached.

The sign must monitor communications with the group controller and blank the display if loss of communication is experienced. The communications timeout period shall be configurable, and the range and factory default settings are shown in Appendix D.

The sign shall be able to detect LED failure, even if the LEDs may be required to be 'off' at the time of the periodic check. The display must be blanked upon failure of 4 or more of contiguous pixels either horizontally or vertically for each displayed image or failure of more than 20% of LEDs.

Upon establishing connection to sign(s), power up, or after a mains power failure, the group controller shall immediately blank the respective sign(s) for a specified period and re-transmit the respective frame(s) to be displayed.

On power restoration, the sign shall become available for activation and remain blank until commanded by the group controller. At no time shall partial or incomplete frames be displayed. The 'Power recovery delay time' shall be configurable and the range and factory default settings are shown in Appendix D.

Facilities must be included to detect failures within the display control system with the sign defaulting to a pre-determined display when major faults are detected.

9.7 Fall-back operation

This Technical Specification accepts Section 6.7 *Fall-back operation* of AS 5156 with the following amendments:

Delete

'The purchaser shall specify the pre-defined fall-back operation.'

Add

The sign shall blank the display in the event of a sign processor fault, communication fault, major display fault. Time to blank shall be configurable and the range and factory default settings are shown in Appendix D.

The group controller must allow each sign's display to remain blank for a minimum time once the display has been blanked irrespective of the cause. This minimum blank time and range is also shown in Appendix D.

Single LED failure, provided that the cumulative LED loss remains below 4 contiguous pixels either vertically or horizontally and/or 20% thresholds described above in Clause 6.6 or VSLS / LUMS light sensor failure, should not result in blanking of the display.

9.8 Software development

This Technical Specification accepts Section 6.8 *Software development* of AS 5156.

9.9 Operation and maintenance manual

This Technical Specification accepts Section 6.9 *Operation and maintenance manual* of AS 5156.

9.10 Group controller

This Technical Specification provides the following Queensland specific information:

The control system requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. The normal connection of the group controller to the TMS shall be through the primary communications port. Additional group controller control system requirements for equipment provided under this specification are described below.

As a minimum, the group controller must:

- i) support at least six physically connected signs
- ii) support a sign ID to identify the correct sign connected to correct port at the group controller
- iii) monitor, log and report its own operation and status
- iv) monitor, log and report the operation of each connected sign individually
- v) allow the signs to be controlled individually or as a logical group

- vi) be capable of storing up to 255 frames in its non-volatile memory
- vii) command signs to display only the permissible frame combinations for that respective site
- viii) allow local automatic reset of sign displays and the group controller itself, such as via watchdog(s)
- ix) be capable of dimming connected signs based on the average of the light sensor outputs
- x) accept / reject valid or invalid commands made by the TMS and/or PHCS, and
- xi) in conjunction with the TMS, ensure that a unique electronic identification is generated for each site.

Additional information and functionality of the group controller required is described in the following sections.

9.10.1 Communication timeout

This Technical Specification provides the following Queensland specific information:

The group controller must be capable of monitoring loss of communications with the TMS and timeout after a specified period. When the group controller is in the 'REMOTE' mode, expiry of this time period must cause the group controller to blank all physically connected signs. This period shall be a configurable parameter and is denoted 'Session timeout'. The range and factory default settings of session timeout is shown in Appendix D. The group controller must also be capable of monitoring communications with the signs connected to it and timeout after a specified period when such communication is lost. Communications timeout check shall be performed periodically as shown in Appendix D. In 'LOCAL' mode, the session timeout check with the TMS shall be ignored.

9.10.2 Sign fault management

The following Queensland specific requirement shall be complied with for both VSLS and LUMS:

In the event of a sign blanks due to a fault, all signs within that group shall be blanked too.

9.10.3 Sign running time

This Technical Specification provides the following Queensland specific information:

If specified in a contract, group controller shall log accumulated running time of the LED boards of each sign. The group controller shall have the capacity to reset timers when the signs are replaced with new signs.

9.11 Sign controller

This Technical Specification provides the following Queensland specific information:

The control system requirements defined in MRTS201 *General Equipment Requirements* apply to this specification. Additional control system requirements for equipment provided under this specification are described below.

9.11.1 General

Each sign shall be directly connected to the group controller using a unique RS-422 serial communications port. Tool-free connectors offering physical security must be used for this purpose. The connectors must be rated appropriately so that it shall not breach the IP65 rating of the sign enclosure.

The sign communications port must provide all the functionality required for the sign to be controlled and monitored by the group controller.

Where a maintenance communication port is provided in the sign, it shall have higher priority over the sign's control communications port. Control shall revert to the control communications port once its maintenance port is not in use. Each sign must have the ability to self-monitor pixel faults, temperature and service status requests from the group controller.

9.11.2 Sign identification

The sign shall have a facility to set a sign ID that can be set externally but readable by the group controller to identify the sign.

9.11.3 Sign maintenance communications port

The maintenance communications port must allow interrogation and control of the sign using the PHCS.

9.11.4 Sign control communications port

The sign shall be connected to the group controller using this port. The communications protocol must be such that full functionality of the group controller as described above is supported.

9.11.5 Light sensors

Each sign must provide at least 2 light sensors to detect ambient light levels. These sensors must be located as follows:

- one sensor facing forward perpendicular to the sign face, and
- one sensor facing backward perpendicular to the sign face.

The sign shall be capable of reporting the light sensor fault to the group controller. A sign mounted directly against a gantry or in a tunnel where provision of more than one sensor may not result in additional benefits, may be equipped with one sensor.

9.11.6 Bus arbitration

The sign must act as a slave on the group controller RS-422 / modem bus.

9.12 Frame display time

This Technical Specification provides the following Queensland specific information:

The minimum display duration of each frame shall be configurable and accessible via the PHCS. The time range and factory default settings are shown in Appendix D.

9.13 Permissible Frame Combinations (PFC) and rules

The Technical Specification provides the following Queensland specific information:

The group controller shall store only those frames permitted to be displayed at its respective site. It shall ensure that only permissible combinations of frames for that site are displayed on its respective signs.

The group controller shall generate, log and report an alarm if a frame display request by the TMS is for non-permissible frame(s) and/or combination of frames.

The group controller shall allow:

- a) the PHCS to read and write its permitted frames and permitted frame combinations (PFC), and
- b) its stored frames to be downloaded to the sign(s) only as required to be displayed.

The permissible frames and PFC for each site shall be confirmed with the Principal. This includes the default, maximum and minimum speeds allowed at the respective VSL site.

The PFC at each site shall be determined in accordance with the following rules:

- a) signs displaying speed must display the same speed
- b) exit arrows shall not point towards each other
- c) exit arrows are only allowed at the VSL / LUMS site immediately upstream of an exit ramp
- d) a left exit arrow may only be shown in the left lane(s), corresponding to the respective exit lane(s) available; and
- e) a right exit arrow may only be shown in the right lane(s), corresponding to the respective exit lane(s) available.

9.14 Frame numbering

The speed limit display frames shall be numbered as follows:

- Frame number shall have 3 digits as 'xyz'
- 'xy' multiply by 10 denotes the speed numerals of the speed display frames; and
- 'z' represents the display attribute of annulus, '0' denotes fixed annulus and '1' denotes flashing annulus for speed display frames.

At each site, only one frame shall be provided for each speed as follows:

- a) the frame for the 'default speed' shall be provided with a fixed annulus, and
- b) all other speeds lower than the default shall be provided with flashing annuli.

Other displays for lane use management displays shall be numbered as per Table 9.14.

Table 9.14 – Other display frames

Frame no	Display	Description
182	Up-left arrow	no annulus
183	Up-right arrow	no annulus
184	Flashing cross	no annulus
185	Flashing cross	no annulus
253	Solid cross	no annulus

Example A: The group controller for a post mounted VSLS site on a motorway with a default speed of 90 km/h and minimum speed of 40 km/h shall be programmed with only frames 41, 51, 61, 71, 81, 90.

Example B: The group controller for a gantry-mounted VSL / LC site on a motorway with a default speed of 90 km/h, minimum speed of 40 km/h and no downstream exit ramp prior to the next VSL / LC site shall be programmed with only frames 41, 51, 61, 71, 81, 90, 184, 185, 253.

9.15 Unique hardware identifiers

This Technical Specification provides the following Queensland specific information:

Each VSLS / LUMS site must be uniquely identifiable. A unique site hardware identifier must be implemented physically, external to the group controller, such as by jumper settings, dip switch, soldered bits or otherwise. The unique ID shall be permanently attached to the field cabinet. This ID must be able to be translated electronically through the group controller. A checksum unique to each site shall be computed based on the permitted frames, PFC and hardware site identifier to form the unique VSLS / LUMS site ID identifiable by the TMS.

The checksum shall be available for confirmation by the TMS that the permitted frames and PFC at each VSLS site are the same as those stored at the TMC. The checksum shall be verified periodically and recomputed each time the permitted frames and/or PFC is changed and/or that the group controller is reset / rebooted.

9.16 Configuration management

This Technical Specification provides the following Queensland specific information:

All settings in the group controller, including settings included in Appendix D, the permissible frames and PFC must be accessible using the PHCS. The configuration shall be site-specific and must ensure that only the group controller with the correct configuration for the respective VSLS site is allowed to control its respective VSLS site.

The site-specific permitted frames, PFC and other user configurable settings shall be stored in non-volatile memory, so that they can be altered and downloaded from the PHCS without requiring any change to the group controller firmware.

10 Environmental requirements

10.1 Temperature and humidity

This Technical Specification accepts Section 7.1 *Temperature and humidity* of AS 5156 with the following addition:

Add:

The environmental requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

Each sign must provide at least one temperature sensor to measure the temperature inside the enclosure at points of high thermal stress. The sensor must not be mounted directly against the top face of the enclosure. The temperature reading data must be transmitted to the communications ports. The temperature must be in units of (°C).

The group controller must have the ability to provide to the TMS temperature readings obtained from the signs connected to it.

10.2 Enclosure protection

This Technical Specification accepts Section 7.2 *Enclosure protection* of AS 5156.

10.3 Wind loading

This Technical Specification accepts Section 7.3 *Wind loading* of AS 5156.

10.4 Vibration

This Technical Specification accepts Section 7.4 *Vibration* of AS 5156.

11 Other requirements

11.1 Installation requirements

This Technical Specification provides the following Queensland specific information:

The installation requirements defined in MRTS200 *General Requirements for ITS Infrastructure* and MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional installation requirements relevant under this Technical Specification are described below.

- a) the general layout, positions, reduced level for the footing (where applicable), and speed zones for the VSLS and/or VSLS / LUMS and details of the barrier and other mounting requirements, must be as shown on the design documentation
- b) the position of in-ground mounting structures must comply with the requirements of the MUTCD
- c) the positioning of VSLS and/or VSLS / LUMS must provide sight distances as described in QGTM Part 10 / AGTM Part 10, and
- d) the VSLS and/or VSLS / LUMS locations must be verified by site inspection and must be shown on the design documentation. The design documentation must be submitted to the Administrator not less than seven days prior to the commencement of civil works for the VSLS and/or VSLS / LUMS foundations. **Milestone**

Before installation, the Contractor must confirm the final VSLS and/or VSLS / LUMS location and the type, location and positioning of the mounting arrangements and/or protection barrier as shown in the design documentation to the Administrator.

11.2 ITS network telecommunications

This Technical Specification provides the following Queensland specific information:

The telecommunications requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification

11.3 Testing and commissioning

11.3.1 General

This Technical Specification provides the following Queensland specific information:

The testing and commissioning requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional testing and commissioning requirements relevant under this Technical Specification are described as follows:

11.3.1.1 Factory acceptance tests

This Technical Specification provides the following Queensland specific information:

Compliance with the optical performance requirements must be determined by measurement under laboratory conditions as per AS 5156:2020. **Witness Point 1 Witness Point 2**

11.3.1.2 Test VSLS and/or VSLS / LUMS

This Technical Specification provides the following new Queensland specific information:

A test VSLS and/or VSLS / LUMS complete with group controller must be provided to the Principal as part of the STREAMS Acceptance Test Plan (SAT) for testing of software components used to control the VSLS and/or VSLS / LUMS. Provision of the test VSLS and/or VSLS / LUMS will not be necessary if a test VSLS and/or VSLS / LUMS has previously passed a SAT or if the Principal specifies otherwise.

The test sign for the STREAMS Acceptance Test Plan may be a smaller version of the sign to be supplied under the contract. It must, however, be functionally equivalent with identical communications interface and operations.

11.3.2 Configuring frames

This Technical Specification provides the following Queensland specific information:

Permissible frame combinations shall be configured as part of the commissioning process. The maximum speed limits for speeds set in local control mode shall not exceed the otherwise statically signed speed limit for that location.

11.4 Documentation

This Technical Specification provides the following new Queensland specific information:

The documentation requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

11.4.1 Asset Data

Once each ITS asset type being installed is known, this shall be communicated to the Principal at first opportunity. This is required to ensure assets are recorded in the Road Operations Asset Register (ROAR) and have appropriate asset IDs and site IDs.

11.5 Training

This Technical Specification provides the following Queensland specific information:

The training requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

11.6 Maintenance

This Technical Specification provides the following Queensland specific information:

The maintenance requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

11.7 Handover

This Technical Specification provides the following Queensland specific information:

The handover requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

Appendix A Photometric test procedures (normative)

A1 General

This Technical Specification accepts Section A1 *General* of AS 5156.

A2 Test procedures for luminance ratio measurement

A2.1 General

This Technical Specification accepts Section A2.1 *General* of AS 5156.

A2.2 Luminance ratio of annulus

This Technical Specification accepts Section A2.2 *Luminance ratio of annulus* of AS 5156.

A2.3 Luminance ratio of numeral matrix

A2.3.1 General

This Technical Specification accepts Section A2.3.1 *General* of AS 5156.

A2.3.2 Alternative A

The Technical Specification accepts Section A2.3.2 *Alternative A* of AS 5156.

A2.3.3 Alternative B

This Technical Specification accepts Section A2.3.3 *Alternative B* of AS 5156.

A2.3.4 Luminance ratio of speed signs with discrete numerals

This Technical Specification accepts Section A2.3.4 *Luminance ratio of speed signs with discrete numerals* of AS 5156.

A2.4 Luminance ratio of conspicuity devices

A2.4.1 General

This Technical Specification accepts Section A2.4.1 *General* of AS 5156.

A2.4.2 Alternative A

This Technical Specification accepts Section A2.4.2 *Alternative A* of AS 5156.

A2.4.3 Alternative B

This Technical Specification accepts Section A2.4.3 *Alternative B* of AS 5156.

A3 Test procedures for luminance measurement

A3.1 General

This Technical Specification accepts Section A3.1 *General* of AS 5156.

A3.2 Luminance measurement of annulus segment

This Technical Specification accepts Section A3.2 *Luminance measurement of annulus segment* of AS 5156.

A3.3 Luminance measurement of the numerals

A3.3.1 Luminance measurement of full matrix speed signs

This Technical Specification accepts Section A3.3.1 *Luminance measurement of full matrix speed signs* of AS 5156.

A3.3.2 Luminance measurement of speed signs with discrete numerals

This Technical Specification accepts Section A3.3.2 *Luminance measurement of speed signs with discrete characters* of AS 5156.

A3.4 Normalization of results

A3.4.1 Normalized luminance

This Technical Specification accepts Section A3.4.1 *Normalized luminance* of AS 5156.

A3.4.2 Test procedure for determination of CF for numerals and the annulus

This Technical Specification accepts Section A3.4.2 *Test procedure for determination of CF for numerals and the annulus* of AS 5156.

A4 Test procedures for luminous intensity half-angle measurement

A4.1 Luminous intensity half-angle of the annulus

This Technical Specification accepts Section A4.1 *Luminous intensity half-angle of the annulus* of AS 5156.

A4.2 Luminous intensity half-angle of the numeral display

This Technical Specification accepts Section A4.2 *Luminous intensity half-angle of the numeral display* of AS 5156.

A5 Test procedures for luminous intensity uniformity

This Technical Specification accepts Section A5 *Test procedures for luminous intensity uniformity* of AS 5156.

A6 Test procedures for conspicuity devices

A6.1 Luminous intensity of conspicuity device

This Technical Specification **does not accept** Section A6.1 *Luminous intensity of conspicuity device* of AS 5156. **This section does not apply in Queensland.**

A6.2 Luminous intensity of half-angle of conspicuity device

This Technical Specification **does not accept** Section A6.2 *Luminous intensity of half-angle of conspicuity device* of AS 5156. **This section does not apply in Queensland.**

A7 Colorimetric test procedures

This Technical Specification accepts Section A7 *Colorimetric test procedures* of AS 5156.

Appendix B Standard bitmap display images (informative)

This Technical Specification accepts Appendix B of AS 5156.

Appendix C Allocation of functionality between TMS and group controller (normative)

This Technical Specification provides the following Queensland specific information:

Table C1 – Allocation of functionality between TMS and group controller: General principles

Design principle	Description	Responsibility		Comments
		TMS	Group controller	
1	Conflicting speed recommendation from algorithms	Y		
2	Future development of algorithms, addition or replacement of algorithms	Y		
3	Max / min speed limit	Y	Y	Permissible frame, STREAMS cannot override max / min speeds which are programmed into the group controller
4	Speed limit minimum increment, 10 or 20 km/h	Y		
5	Automatic functionality, speed change from 60 to 110 km/h (where applicable)	Y	Y	Permissible frames
6	Buffer Speed, speed changes greater than 20 km/h	Y		
7	Buffer Distance, at least 300 m in accordance with MUTCD	Y		
8	Transitions, change of lane status and/or speeds	Y		
9	Flashing annulus		Y	If speed is other than default (maximum) speed limit, then flash inner rings of annulus
10	20 km/h speed limit lowering	Y		
11	20 km/h speed limit raising	Y		
12	Speed limit at start of VSLS zone	Y		
13	Smoothing	Y		
14	Smoothing	Y		
15	Smoothing	Y		
16	Smoothing	Y		
17	Smoothing	Y		
18	Min length of target speed limit changes	Y		
19	Manual override lane use management	Y		PHCS not to inadvertently override lane use management

Design principle	Description	Responsibility		Comments
		TMS	Group controller	
20	Flashing red cross before solid red cross	Y		STREAMS will request flashing cross, THEN after x seconds, request solid cross. Sign protocol development required
21	Lane closures for multiple lanes	Y		
22	Default lane closure length	Y		
23	Minimum lane closure length	Y		
24	System prompt for lane closure, lane closure length	Y		
25	Lane closure across entrance or exit ramps	Y		Separate group controllers required for ramp and mainline
26	Speed limit during lane closures	Y	Y	Permissible frames
27	Incidence clearing and lane reopening	Y		
28	Re-opening lanes	Y		
29	Manual override over a number of signs by operator	Y	Y	Permissible frame combinations
30	Changes by time of day, manual override	Y		
31	Manual override speeds	Y		
32	Responsibility associated with manual override	Y		Note also responsibility when using PHCS
33	Power of the manual operator override	Y		
34	Manual override operator timeout	Y		
35	Shift changes while manual overrides are activated	Y		
36	User interface, prompts and manual overrides	Y		
37	Switched on	Y	Y	
38	Manage different directions separately	Y		
39	Appropriate sign displays for safety		Y	Permissible frame combinations
40	Confirmation that sign display has changed	Y	Y	Sign protocol
41	Generic plans for incident management	Y		
42	Sign interlocking, mainline / entrance ramp	Y		Ramp signs to have own controller

Design principle	Description	Responsibility		Comments
		TMS	Group controller	
43	Queuing object	Y		
44	Auditing email account	Y		
45	Calibration, fine tuning of algorithms	Y		
46	Management of parameters	Y		
47	Interaction with STREAMS incident management system (SIMS)	Y		
48	Differential lane speeds	n/a	Possible future (by others)	Permissible frame combinations
49	Sign spacing	Y		
50	Optimum location beyond on ramp taper	Y		
51	Unobstructed viewing distance	Y		
52	Default speed limit (when VSLS system is not available)	n/a	n/a	Static signs

Table C2 – Allocation of functionality between TMS and group controller: Fault Management

Design principle	Description	Responsibility		Comments
		TMS	Group controller	
1	VSLS / LUMS displays incorrect symbol		Y	
2	Inability to determine VSLS / LUMS display		Y	Watchdog timer
3	System operator alert		Y	Protocol to allow
4	Failure of pole-mounted VSLS at VSLS zone entry	Y	Y	Solution will now be through the hardware (previously in STREAMS)
5	Failure of pole-mounted VSLS where upstream VSLS site displays same speed	Y		
6	Failure of pole-mounted VSLS where upstream VSLS site displays slower speed than the faulty site	Y		
7	Failure of pole-mounted VSLS where upstream VSLS site displays faster speed than the faulty site	Y		

Design principle	Description	Responsibility		Comments
		TMS	Group controller	
8	Failure of gantry-mounted VSL signs (at VSL zone entry)	Y	Y	Solution now to be through hardware (group controller)
9	Failure of gantry-mounted VSL signs where upstream VSL site displays same speed	Y		
10	Failure of gantry-mounted VSL signs where upstream VSL site displays slower speed	Y		
11	Failure of gantry-mounted VSL signs where upstream VSL site displays faster speed than faulty site	Y		
12	Maximum uptime without communications	Y	Y	Set in STREAMS
13	Power recover delay time		Y	Hardware waits for instruction from STREAMS
14	Sign display minimum downtime		Y	
15	Maximum rollback	Y		
16	Non-consecutive faulty sites	Y		
17	Rollback onto upstream motorways	Y		
18	Rollback scheme for lane closure	Y		
19	Rollback scheme for lane closure zone	Y		
20	Failure of interlocked signs, mainline entry ramp	Y		

Appendix D Referenced variables and default settings (normative)

This Technical Specification provides the following Queensland specific information:

Table D – Referenced variables and default settings

Reference	Description	Range of values	Factory default	Device(s), systems affected
9.1.2	Frame display time	1-5 seconds	5 seconds	Group controller / sign
8.2.5	Flashing display elements	1 second / Duty cycle 50%	1 seconds / Duty cycle 50%	Sign
9.10.1	Session timeout (group controller / TMS)	1-600 seconds	60 seconds	Group controller / TMC
9.10.1	Communications check with sign	0-30 seconds	Once every 5 seconds	Group controller
9.6	Power recovery delay time	1-600 seconds	60 seconds	Group controller / sign
9.7	Minimum blank time	1-120 seconds	30 seconds	Group controller / sign
9.7	Sign processor fault blank time	0.5-3 seconds	1 second	Sign
9.7	Communication timeout (sign / group controller)	1-600 seconds	60 seconds	Sign
5.1.1.6.1	LED intensity control	1-16 levels	Dimming by SC	Group controller / sign

