

Master Specification

Part RD-ITS-C1

Installation and Integration of ITS Equipment

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RD-ITS-C1 Installation and Integration of ITS Equipment

1 General

- a) This Master Specification Part sets out the requirements for the installation and integration of equipment for intelligent transport systems (ITS), including:
- i) the documentation requirements, as set out in section 2;
 - ii) the electrical and telecommunications requirements, as set out in section 3;
 - iii) the STREAMS integration requirements, as set out in section 4;
 - iv) the installation requirements, as set out in section 5;
 - v) the requirements for vehicular site maintenance access, as set out in sections 6;
 - vi) the requirements for non-vehicular site maintenance access, as set out in section 7;
 - vii) the requirements for maintenance access paths, as set out in section 8;
 - viii) the testing and commissioning requirements, as set out in section 9;
 - ix) the requirements for the fabrication and installation of support structures, as set out in section 10;
 - x) the handover requirements, as set out in section 11;
 - xi) the training requirements, as set out in section 12;
 - xii) the warranty and spare parts requirements, as set out in section 13;
 - xiii) the Defects Liability Period and management of Defects requirements, as set out in section 14; and
 - xiv) the Hold Point requirements, as set out in section 15.
- b) The installation and integration of ITS equipment must comply with the Reference Documents, including:
- i) AS 1100 Technical drawing;
 - ii) AS/NZS 1170.2 Structural design actions, Part 2: Wind actions;
 - iii) AS 1428 Design for access and mobility;
 - iv) AS 1657 Fixed platforms, walkways, stairways and ladders - Design, construction and installation;
 - v) AS 1742.2 Manual of uniform traffic control devices - Traffic control devices for general use;
 - vi) AS 1742.15 Manual of uniform traffic control devices, Part 15: Direction signs, information signs and route numbering;
 - vii) AS 1906.1 Retroreflective materials and devices for road traffic control purposes, Part 1: Retroreflective sheeting;
 - viii) AS 2312 Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings;
 - ix) AS 2700 Colour standards for general purposes;
 - x) AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
 - xi) AS/NZS 3008 Electrical installations - Selection of cables;

- xii) AS/NZS 3845 Road safety barrier systems and devices;
- xiii) AS 5100 Bridge design;
- xiv) AS/NZS ISO 9001 Quality management systems - Requirements;
- xv) AS/CA S008 Requirements for customer cabling products;
- xvi) AS/CA S009 Installation requirements for customer cabling (Wiring Rules);
- xvii) Department Operational Procedure TOP059 - Project Delivery IP/Password/User transfer procedure (available upon request); and
- xviii) Department Completion Procedure For ITS Defect Free Period (available upon request).

2 Documentation

2.1 Design Documentation

In addition to the requirements of PC-EDM1 “Design Management”, the Design Documentation must include:

- a) fully detailed location and layout documentation for all ITS equipment to be installed pursuant to this Master Specification Part;
- b) general layout, reduced levels, equipment position, coordinates or offsets, speed zones, conduit and pit locations, mounting structure positions and any protective barriers; and
- c) details of equipment brackets and support connections.

2.2 Construction Documentation

In addition to the requirements of PC-CN3 “Construction Management”, the Construction Documentation must include:

- a) evidence of electrical licensing requirements as required by section 3.1e);
- b) evidence of communications cabling licensing requirements as required by section 3.1g);
- c) evidence of STREAMS interoperability and compatibility for all ITS equipment to be operated by STREAMS, as required by sections 4a) and 4b);
- d) evidence of compliance with:
 - i) RD-ITS-D1 “Design of ITS Equipment”;
 - ii) RD-ITS-S1 “General Requirements for the Supply of ITS Equipment”; and
 - iii) other relevant Master Specification Parts for the supply of the particular ITS equipment, as required by section 5.1;
- e) the Testing and Commissioning Management Plans required by section 9.2a); and
- f) Shop Drawings for gantries and major support structures required by section 10.3.

2.3 Quality Management Records

- a) In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), but subject to section 2.3b) the Quality Management Records must include:
 - i) all test results and documentation required by section 9.3.1c);
 - ii) technical data including manufacturer, model, hardware, firmware or software version of all installed ITS equipment, as required by section 11.3b); and

- iii) details of warranty periods and a description of warranty claim procedures and conditions as required by section 13d).
- b) The Contractor must ensure that all configured passwords, usernames and encryption keys:
 - i) are not included in the Quality Management Records, or any other records for which access is not restricted; and
 - ii) are provided to the Team Leader TrafficNet in accordance with section 3.4a)ii).

2.4 Training Manual

In addition to the requirements of PC-CN2 “Asset Handover”, the Training Manual must include a training plan relevant to the ITS equipment which must include the training information required by section 12.

2.5 Maintenance Manual

In addition to the requirements of PC-CN2 “Asset Handover”, the Maintenance Manual must include:

- a) routine/preventative maintenance recommendations including maintenance schedules for all installed ITS equipment;
- b) safe access methods for all locations requiring maintenance access; and
- c) replacement part requirements, including details of part suppliers and a list of recommended spare parts stock.

3 Electrical and telecommunications requirements

3.1 General

- a) The Contractor must ensure that all electrical installations relevant to the installation and integration of ITS equipment comply with the requirements of RD-ITS-C2 “Mains Power Supplies for Roadside Traffic Management Equipment” and where relevant, TUN-ME-DC2 “Tunnel Power Systems”.
- b) The Contractor must ensure that all telecommunication installations relevant to the installation and integration of ITS equipment comply with the requirements of RD-ITS-C3 “Telecommunications Cabling”.
- c) Where there is a discrepancy between the requirements of:
 - i) AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules); and
 - ii) AS/CA S009 Installation requirements for customer cabling (Wiring Rules),regarding installations where both telecommunications and electrical services are installed in close proximity, the Contractor must comply with the requirements of the more conservative of the 2 requirements.
- d) The Contractor must ensure that electrical work relating to the installation and integration of ITS equipment is only carried out by an electrical worker who is suitably qualified and licensed to perform the relevant works.
- e) The Contractor must provide evidence of the electrical worker licence (as required by section 3.1d)) to the Principal as part of the Construction Documentation, prior to the commencement of the relevant electrical Works by the Contractor.
- f) The Contractor must ensure that communications cabling work relating to the installation and integration of ITS equipment is only carried out by a worker who is suitably qualified and registered to perform the relevant works.

- g) The Contractor must provide evidence of the communications cabling worker licence (as required by section 3.1f)) to the Principal as part of the Construction Documentation, prior to the commencement of the relevant communications cabling Works by the Contractor.

3.2 Cables, conduits and pits

- a) The Contractor must install all conduits, pits and cables necessary for the provision of communications and power to the ITS equipment.
- b) The Contractor must ensure that all:
- i) conduits and pits comply with the requirements of:
 - A. RD-EL-D3 “Conduit Design For Road Lighting, Traffic Signals and ITS”; and
 - B. RD-EL-C3 “Supply and Installation of Conduits and Pits”;
 - ii) electrical cables comply with the requirements of AS 3008 Electrical installations - Selection of cables; and
 - iii) telecommunications cables comply with the requirements of RD-ITS-C3 “Telecommunications Cabling”.
- c) Prior to installation of conduits and pits, the Contractor must clearly mark the proposed position of conduits and pits (including sizes and types) on the surface.
- d) The Contractor must ensure that for roadside ITS devices:
- i) a pit is installed adjacent to each item of ITS equipment;
 - ii) ITS cabinets have separate power and communications pits; and
 - iii) where single devices share a common power and communications pit, segregation requirements are satisfied.
- e) The Contractor must:
- i) ensure that:
 - A. all cables are continuous and without joints except:
 - I. at termination points; or
 - II. where the cable size is required to be reduced; and
 - B. cable joints are accessible and not located within conduits;
 - ii) not place excessive strain on any individual core, individual cable or cables during the drawing in process;
 - iii) label all cables and terminations with permanent markings, which must not be handwritten;
 - iv) maintain adequate segregation between LV, ELV and data cables; and
 - v) leave adequate spare cable in loops in pits, to enable cost efficient and timely repair in the event that the cables are damaged or severed.
- f) For roadside ITS equipment (excluding ITS equipment located within Tunnels), the Contractor must:
- i) supply and install a submersible line fuse holder in an isolation pit located between the SAPN connection point and the ITS cabinet or distribution board;
 - ii) ensure that the isolation pit required by section 3.2f)i) is located as near as practicable to the SAPN connection point;
 - iii) provide an earth stake in a pit adjacent to each ITS cabinet and distribution board; and
 - iv) ensure that the earth stakes required by section 3.2f)iii) comply with the following:

- A. the earth stakes must protrude into the service pit by a minimum of 150 mm;
- B. where required by the Contract Documents, the earth stakes in pits must also be provided adjacent to other ITS equipment; and
- C. only copper clad, copper plated earth stakes or solid copper strips (as a minimum) may be used.

3.3 Fusing and isolation

The Contractor must ensure that the installation and integration of ITS equipment satisfies the following fusing and isolation requirements:

- a) where ITS equipment is powered sequentially, the Contractor must ensure that each ITS cabinet and switchboard:
 - i) is protected by a fuse or circuit breaker; and
 - ii) contains a sub main fuse or circuit breaker;
- b) fuses and circuit breakers must be “cascaded” in rating such that a fault in a submain will only result in the fusing or tripping of the sub main fuse or circuit breaker;
- c) where field devices (including downstream cabinets that are powered from upstream cabinets) are located more than 50 m from a cabinet supplying them with power, each field device must be capable of being easily isolated at its location (e.g. via a local circuit breaker or fuse which is accessible from ground level);
- d) power reticulation to each device must include a method of protection or isolation so that:
 - i) in the event of a device being damaged or suffering an internal or cabling fault which activates (i.e. blows) a supply fuse, the blown fuse only removes power to that device, and no other devices; and
 - ii) in the event that a device needs to be isolated, the supply for that device can be easily and safely isolated at the device, and also at the pit from which the device is powered; and
- e) the requirements of this section 3.3 may be satisfied by:
 - i) installing a fuse or circuit breaker at the device; or
 - ii) installing an inline submersible fuse in the pit from which the power supply for that device is derived.

3.4 Network device configuration

The Contractor must ensure that the installation and integration of ITS equipment satisfies the following network device configuration requirements:

- a) the ITS communication network must be configured with the following security requirements:
 - i) SNMP devices must be configured for SNMP v3 authentication and privacy (auth/priv) using non-default temporary passwords (and usernames if possible) and encryption keys;
 - ii) configured temporary passwords, usernames and encryption keys must be kept confidential at all times, and be provided to the Team Leader TrafficNet prior to SIAT to facilitate them being added to the Principal’s network monitoring software;
 - iii) temporary passwords must be user updateable;
 - iv) management of IP addresses and passwords must comply with the Department Operational Procedure TOP059 - Project Delivery IP/Password/User transfer procedure;

- v) network devices must be configured to use the strongest available authentication and encryption hashes. For example:
 - A. for authentication, SHA1 must be used over MD5 where the network device supports SHA1; and
 - B. for encryption, AES-256 must be used over the following (in descending order):
 - I. AES-192; and
 - II. AES-128;
- vi) network-connected devices support remote logging using the “Syslog” protocol. The Contractor must obtain details of the Principal’s syslog servers together with the IP address assignments from the Principal;
- vii) Layer 2 network links provide a means of detecting and raising alarms for unidirectional network links (Unidirectional Link Detection);
- viii) all network switches, routers and firewalls must be configured for “RADIUS Authentication/Authorisation and Accounting” using the Principal’s TrafficNet RADIUS servers. The Contractor must request the relevant configuration and IP address details from the Principal and must make allowance of 10 Business Days for provision of such information;
- ix) the Contractor’s request for configuration and IP address details pursuant to section 3.4a)viii) must include:
 - A. the ITS network Final Design Documentation; and
 - B. a spreadsheet listing all of the assets requiring an IP address; and
- x) firewalls must be configured to:
 - A. allow all outgoing connections from TrafficNet to the field networks; and
 - B. block all connections from the field network into TrafficNet except those required for normal equipment operation;
- b) the Contractor must configure all network-connected devices that are to be connected to the following systems required by RD-ITS-D1 “Design of Intelligent Transport Systems (ITS)”:
 - i) the Principal’s automated security monitoring systems; and
 - ii) the Principal’s automated network performance monitoring systems;
- c) all network-connected devices that use real-time clocks must synchronise their clocks with the Principal’s network time servers using network time protocol (NTP). The IP addresses of relevant time servers are to be requested from the Principal by the Contractor pursuant to section 3.4a)viii);
- d) all network equipment must be configured to satisfy the following requirements:
 - i) all network-connected devices that require name resolution must use the Principal’s TrafficNet domain name service (DNS) servers. The IP addresses of the DNS servers will be provided by the Principal along with the IP address assignments as detailed in part 3.4a)viii);
 - ii) all multi-layer switches and routers must be configured with a loopback interface that will be assigned a host address (/32) by the Principal as detailed in part 3.4a)viii). This loopback interface must be used for the purposes of PIM routing, as the router identifier for the dynamic routing protocol and as the source interface for NTP, DNS and RADIUS authentication requests and must be the primary management address used for access to the device. The loopback interface must be advertised as an internal route by the dynamic routing protocol; and

- iii) the management address for Layer 2 switches (both field and CER access switches) must be configured on a virtual local area network (VLAN) other than VLAN 1 for management access;
- e) all network information provided to the Contractor by the Principal must be treated as sensitive information and is provided on a commercial-in-confidence basis;
- f) the Contractor must obtain the Principal's approval of proposed network configurations for all network equipment;
- g) for the purposes of section 3.4f):
 - i) the Contractor must provide the Principal with at least 5 Business Days' notice for scheduling the Principal's network configuration review;
 - ii) the Contractor must submit to the Principal for approval the proposed network configuration for the relevant network equipment, together with any other information requested by the Principal, in order for the Principal to review all network-connected equipment configurations;
 - iii) the Contractor must allow at least 3 Business Days (or such other time notified by the Principal) for the Principal's review;
 - iv) following the Principal's review, the Principal will either:
 - A. approve the network configuration as-is; or
 - B. suggest or request changes required to ensure compatibility and compliance with existing network practices and procedures; and
 - v) if the Principal requests or suggests changes pursuant to section 3.4g)iv)B, the Contractor must make such changes and resubmit the network configuration for review in accordance with this section 3.4g); and
- h) the Principal's approval of network equipment configuration constitutes a **Hold Point**.

3.5 Core and distribution TrafficNet network

- a) The Contractor is not responsible for the configuration of core and distribution TrafficNet network equipment.
- b) The Contractor must supply all core and distribution TrafficNet network equipment to the Principal for configuration and testing not less than 1 month prior to being required for installation on site.
- c) The receipt of the core and distribution TrafficNet network equipment by the Principal will constitute a **Hold Point**.
- d) Once the Principal confirms that the core and distribution TrafficNet network equipment has been successfully configured and tested, the Hold Point required by section 3.5c) will be released and the Contractor must take formalised delivery of that core and distribution TrafficNet network equipment for installation in accordance with this Master Specification Part.
- e) The Contractor acknowledges that the Principal may undertake post-installation testing of the core and distribution TrafficNet network equipment and that, if the Principal elects to do so, the Contractor must provide a representative to be present during the post-installation testing to rectify any installation-related issues.
- f) The Contractor must ensure that:
 - i) all optical fibre connectors on fibre optic breakout trays are of a type that uses angle-polished connectors (e.g. SC-AP);
 - ii) fibre optic patch cables are selected in accordance with RD-ITS-C3 "Telecommunications Cabling"; and

- iii) all connectivity between switches devices of the same type (e.g. switch-to-switch, router to router) must:
 - A. be made using network cross-over cables of suitable configuration; and
 - B. not rely on auto negotiation of cable pin outs.

3.6 Network device support and monitoring

- a) All installed ITS network equipment must be covered by a maintenance and support agreement as required by RD-ITS-S1 "General Requirements for the Supply of ITS Equipment".
- b) Network equipment must include licences for the Principal's automated security monitoring systems and the Principal's automated network performance monitoring systems as required by RD-ITS-S1 "General Requirements for the Supply of ITS Equipment".
- c) All installed ITS equipment must:
 - i) have a published product life cycle (e.g. a published on sale, end of sale notice, end of sale, and end of support cycle) and be on sale or be current equipment at the proposed time of the installation and commissioning;
 - ii) not have a published end of sale or end of support notice at the time of installation and commissioning; and
 - iii) be supported by the supplier for the entire specified Design Life.

3.7 Wireless communications

- a) The Contractor must ensure that wireless communications links to ITS devices are not used unless specifically required by the Contract Documents or approved by the Principal as part of the Design Departure or Non-Conformance processes.
- b) If wireless communication ITS technology has been specified in the Contract Documents or approved by the Principal as part of the Design Departure or Non-Conformance processes, the wireless communication to ITS equipment must comply with:
 - i) RD-ITS-D1 "Design of Intelligent Transport Systems (ITS)";
 - ii) all applicable Australian standards; and
 - iii) all requirements of ACMA.
- c) The Contractor must ensure that:
 - i) wireless communication to devices is to the closest ITS cabinet;
 - ii) communications interface equipment and antennae are installed at the ITS cabinet to facilitate communications between the field processor and the device;
 - iii) antennas are positioned so that ongoing line of sight to the opposite communication partner is guaranteed at all times;
 - iv) antennas are connected to the related equipment via industry standard connectors;
 - v) wireless communications are not affected by normal maintenance activities;
 - vi) antennas are not located on see saw poles; and
 - vii) corresponding communications interface equipment is installed at the device site and is suitably interfaced to the device controller.

4 STREAMS integration

- a) The Contractor must provide evidence of STREAMS interoperability and compatibility for all ITS equipment to be installed as part of the Construction Documentation.

- b) If the Contractor proposes to install ITS equipment not already demonstrated as being STREAMS interoperable and compatible, the Contractor must provide evidence that STREAMS interoperability and compatibility of that ITS equipment as part of the Construction Documentation.
- c) The Contractor must engage Transmax Pty Ltd to undertake the following Works to integrate ITS equipment into STREAMS at the Contractor's cost:
 - i) all necessary testing including at a minimum:
 - A. Factory Acceptance Testing (FAT), in accordance with section 9.3.2;
 - B. Factory Integration Acceptance Testing (FIAT) in accordance with PC-CN1 "Testing and Commissioning";
 - C. Site Acceptance Testing (SAT), in accordance with section 9.3.6;
 - D. System Integration Acceptance Testing (SIAT), in accordance with section 9.3.7;
 - E. Operational Scenario Testing (OST), in accordance with section 9.3.8; and
 - F. User Acceptance Testing (UAT), in accordance with PC-CN1 "Testing and Commissioning";
 - ii) configuration of devices in the STREAMS test server;
 - iii) any required PMCS/PLC integration;
 - iv) GUI and road and equipment layout schematic development;
 - v) operator training;
 - vi) transfer of all devices to the STREAMS production server prior to OST;
 - vii) any new software development in STREAMS, if the selected ITS equipment requires changes to the STREAMS software; and
 - viii) rectification of any STREAMS integration issues detected during the 1,000 hours Defect free period required by section 11.1.
- d) The Principal will arrange with Transmax Pty Ltd the delivery of:
 - i) Operational Scenario Testing (OST); and
 - ii) fault reporting during the 1,000 hours Defect free period required by section 11.1.
- e) The Contractor must ensure that:
 - i) each item of ITS equipment and the associated system allows:
 - A. automatic operation via STREAMS; and
 - B. local manual operation independent of STREAMS;
 - ii) communication with STREAMS is by one of the following means (in the following order of preference):
 - A. direct ethernet or serial connection to a field processor;
 - B. remote ethernet or serial (for example, using a serial or fibre media converter) connection to a field processor located elsewhere or workstation on the Principal's telecommunications network; or
 - C. connection to the TMC and BTMC;
 - iii) ITS equipment that primarily provides data to STREAMS (for example, vehicle detectors), provides event-driven messages to minimise or avoid potential polling between the ITS equipment and field processor or STREAMS;
 - iv) event-driven messages contain a time stamp marking the time the event occurred; and

- v) where communications from the ITS equipment are mostly event-driven, a heartbeat (or status) message must be emitted by the equipment at least every minute.
- f) The Contractor must ensure that it satisfies all STREAMS integration requirements set out in RD-ITS-D1 “Design of Intelligent Transport Systems (ITS)”.

5 Installation requirements

5.1 General

As part of the Construction Documentation, and prior to installation of the ITS equipment, the Contractor must provide records demonstrating compliance with:

- a) RD-ITS-D1 “Design of Intelligent Transport Systems (ITS)”;
- b) RD-ITS-S1 “General Requirements for the Supply of ITS Equipment”; and
- c) all other relevant Contract Documents relevant to the supply or installation of that particular ITS equipment.

5.2 Location and layout

- a) The Contractor must ensure that the general layout and installation of the ITS equipment:
 - i) complies with the requirements of sections 6 and 7;
 - ii) satisfies the requirements of RD-ITS-D1 “Design of Intelligent Transport Systems (ITS)”;
 - iii) is located and installed to provide rapid, easy and safe access for maintenance purposes;
 - iv) minimises, and wherever practicable eliminates, the need for traffic control during maintenance activities; and
 - v) will not be affected by any future road widening or alteration that is detailed in the Contract Documents.
- b) Where ITS equipment is mounted above the carriageway, the Contractor must ensure that the vertical clearance from the bottom of the support structure or the equipment enclosure to the road surface complies with Contract Documents or, where no such requirement is stated, the clearance must be a minimum of 6.0 m.

5.3 Removal of existing ITS, traffic signals and road lighting equipment

- a) The Contractor must decommission and remove to secure store all redundant ITS, traffic signals and road lighting equipment, including support structures, footings and associated cabling.
- b) The Contractor must make good any areas affected by decommissioning and removal of any ITS, traffic signals and road lighting equipment. This includes repairs to remaining structures (e.g. removing surplus brackets, patching holes, repairing finishes, making safe) and making good of surrounding environment (e.g. footpaths, landscaping and so forth).
- c) The Contractor must ensure that any existing ITS, traffic signals and road lighting equipment that is temporarily removed pending later reinstallation is carefully removed and securely stored by the Contractor, pending re-erection.
- d) The Contractor must submit a detailed schedule of equipment to be decommissioned, including individual device details and when each device is to be decommissioned, to the Principal for approval as part of the Construction Documentation.
- e) The decommissioning schedule required by section 5.3d) must remain a live document and the scheduled dates for decommissioning must be kept updated. The Principal can release Hold Points against each device or groups of devices subject to when they are no longer required for operational traffic management.

- f) The Contractor must ensure that decommissioning of any ITS, traffic signals and road lighting equipment does not affect operation of the remaining network equipment.
- g) The Contractor must ensure that any decommissioned equipment is offered to the Principal prior to disposal, and if specified by the Principal, delivered to a nominated depot in the condition that it was prior to removal.

5.4 Wiring

The Contractor must ensure that:

- a) each ITS device site is provided with conduit infrastructure necessary for the complete operation of the ITS device, including cable access from the backbone conduit network to the ITS field cabinet or field device;
- b) ITS cable infrastructure is installed in accordance with RD-ITS-C3 “Telecommunications Cabling”;
- c) after installation of ITS related cabling, the associated conduits and glands are sealed to prevent vermin entry; and
- d) cables for pole mounted ITS devices connect to the ITS device by entering the pole underground at its base, and exiting the pole either:
 - i) directly into the ITS device enclosure (e.g. directly into a pole mounted equipment cabinet); or
 - ii) exiting to the ITS device at a height which prevents access to the conduit while standing at ground level.

5.5 Wiring specification

Subject to other Contract Documents (including in relation to Tunnel wiring), the Contractor must ensure that all ITS wiring complies with the low voltage and ELV wiring specifications set out in Table RD-ITS-C1 5-1.

Table RD-ITS-C1 5-1 Cable wiring colour and minimum size

Application description	Colour	Conductor min. size
230VAC Power (Single phase)	230 VAC active	Red
	230 VAC neutral	Black
	Earth	Green/yellow
230VAC Control	230 VAC active	Red
	230 VAC neutral	Black
48 VDC	48 VDC (+ve)	Orange
	0 VDC (-ve)	Blue
24 VDC	24 VDC (+ve)	Grey
	0 VDC (-ve)	Blue
12 VDC	12VDC (+ve)	Pink
	0 VDC (-ve)	Blue
5 VDC	5 VDC (+ve)	Light blue
	0 VDC (-ve)	Blue

5.6 Equipment enclosures

- a) The Contractor must ensure that all ITS equipment enclosures comply with the requirements of:
 - i) RD-ITS-S3 “ITS Enclosures”;
 - ii) RD-ITS-S2 “Roadside Electrical Switchboards”; and
 - iii) where located within a Tunnel, TUN-ME-DC4 “Tunnel Equipment Cabinets”.

- b) The Contractor must ensure that:
 - i) where equipment enclosures are located in flood-prone areas, enclosures must be installed at an appropriate height above ground level to minimise the risk of inundation;
 - ii) ground mounted equipment enclosures are installed on a concrete plinth;
 - iii) the gap between the concrete plinth and equipment enclosure is vermin-proof and prevents corrosion of the equipment enclosure, or its fixings or the equipment housed within;
 - iv) equipment enclosures are installed such that when all doors are fixed in the open position, visibility of the approaching traffic flow is maximised for maintenance personnel working on the enclosure;
 - v) the concrete plinth is large enough to allow for service personnel to walk on the plinth around the enclosure while all doors and access areas are open;
 - vi) equipment enclosures are positioned to minimise direct solar radiation; and
 - vii) are not painted a dark colour.

5.7 Vehicle barriers

The Contractor must ensure that:

- a) where road-side barrier treatments exist or are required adjacent to the ITS equipment site, the barriers meet the requirements of the Contract Documents; and
- b) where vehicle barriers are to be provided on a road which is trafficked at the time of installation of the ITS equipment, the barriers (or temporary barriers) are installed prior to commencing civil works for the ITS equipment mounting foundations.

5.8 Contamination control mats

Where contamination control mats must be provided for CERs, the Contractor must ensure that:

- a) each member of its personnel accessing the CERs check and tear off layers of the contamination control mat as required or when the mats are dirty enough to have lost their effectiveness;
- b) exhausted contamination control mats are replaced prior to Handover;
- c) as at Handover, at least 2 spare contamination control mats are provided for each CER; and
- d) spare contamination control mats are stored in a suitable storage facility within proximity of the CER to allow for easy replacement.

6 Vehicular site maintenance access

- a) The Contractor must ensure that permanent motor vehicle access points are provided within 50 m of each ITS equipment site (excluding ITS equipment located within Tunnels) to allow maintenance vehicles to safely enter and exit the ITS equipment site from the carriageway.
- b) For the purposes of section 6a), the Contractor must ensure that the construction of maintenance vehicle access points:
 - i) discourages unauthorised vehicles from accessing the site unless the site also contains a help phone or other public facility;
 - ii) accommodates a maintenance vehicle of up to 6 m in length;
 - iii) allows a safe distance for indication and deceleration of a maintenance vehicle in order to safely enter the site by pulling over safely on the shoulder or maintenance bay and either:

- A. driving into the entrance of the maintenance bay if it is a drive through bay; or
 - B. reversing into the maintenance bay if it has a single entry/exit point;
 - iv) allows a safe exit by driving out in the direction of traffic flow (i.e. not reversing) when leaving the maintenance bay with a safe distance and adequate clear vision of the road to accelerate and merge onto the road when leaving the site;
 - v) provides protection to the maintenance vehicle and staff (for example, by allowing the maintenance vehicle to park a safe distance from the carriageway, or behind a safety barrier);
 - vi) ensures maintenance vehicles can enter and park in the access site without protruding into trafficable carriageway lanes (including emergency lanes); and
 - vii) do not require temporary traffic management or speed restrictions to facilitate safe access during maintenance works unless lane closures are required to access ITS equipment adjacent to or located over lanes.
- c) The Contractor must provide a suitable set-up area for the maintenance vehicle required by section 6b) which:
- i) is close enough for safe operation of maintenance activities;
 - ii) allows the maintenance vehicle to be parked within 3 m of the ITS equipment;
 - iii) has the entrance and exit, access track and set-up area suitable for all-weather access for a maintenance vehicle pertinent to the maintenance activity (for example, bitumen or concreted with adequate drainage);
 - iv) is laid out so that the maintenance vehicle has sufficient parking space so that it does not park over any pits in the set-up area when parked adjacent to the ITS equipment; and
 - v) has any pits in the set-up area that may potentially be driven over constructed to be trafficable and not installed in a manner which allows water to pool on or near the pit.

7 Non-vehicular site maintenance access

- a) This section 7 applies only if the Contract Documents specify that vehicular site maintenance access to ITS equipment, as required by section 6, is not required. This section 7 is not applicable to ITS equipment located within Tunnels.
- b) The Contractor must ensure that permanent personnel access points from the carriageway to the ITS equipment site is provided within 5 m of each item of ITS equipment.
- c) For the purposes of section 7b), the Contractor must ensure that the personnel access points:
 - i) are arranged to prevent vehicles from entering the equipment site; and
 - ii) avoid the need for traffic control during maintenance works.
- d) The Contractor must provide a parking area suitable for maintenance vehicles immediately adjacent the personnel access point required by section 7c).
- e) The Contractor must ensure that the parking area required by section 7d):
 - i) allows personnel to alight from both sides of the maintenance vehicle concurrently and access the ITS equipment site without entering trafficable carriageway lanes (including emergency lanes);
 - ii) provides a minimum sight-distance of upstream carriageway (from within the maintenance vehicle) equal to the distance required to allow the maintenance vehicle to accelerate to 80% of the carriageway's posted maximum speed limit; and
 - iii) is laid out so that the maintenance vehicle has sufficient parking space so that it does not park over any pits in the parking area.

8 Maintenance access paths

- a) The Contractor must provide an access path to each ITS equipment site for the safe movement of maintenance personnel (including any required maintenance equipment or tools) between the maintenance vehicle parking area and the ITS equipment.
- b) For the purposes of section 8a), the Contractor must ensure that:
 - i) the access path and the area around the ITS equipment site is evenly graded;
 - ii) the access path does not exceed a 1:3 gradient;
 - iii) the area around the ITS equipment site is suitable for maintaining the ITS equipment in accordance with the Maintenance Manual;
 - iv) the access path and the area around the ITS equipment site is suitable for safe, all-weather access and deters the encroachment of vegetation onto the access path;
 - v) the access path and the area around the ITS equipment site is fitted with safety barriers around the site if working on or near the site would be hazardous without the barriers;
 - vi) a minimum 100 mm thick, rectangular concrete pad is provided for a minimum 1,200 mm width around all ITS equipment enclosures and mounting plinths at the ITS equipment site; and
 - vii) the access path and the area around the ITS equipment site is free of tripping and falling hazards.
- c) The Contractor may provide concrete steps to optimise path alignment.
- d) Where steps are provided pursuant to section 8c), the Contractor must ensure that they comply with all relevant standards and codes.

9 Testing and commissioning

9.1 General

- a) Testing and commissioning must comply with the requirements of PC-CN1 "Testing and Commissioning".
- b) The Contractor must verify that the ITS equipment complies with the requirements of this Master Specification Part by:
 - i) planning and performing testing and commissioning in compliance with the requirements of PC-CN1 "Testing and Commissioning"; and
 - ii) undertaking specific testing and commissioning requirements as detailed in section 9.3.
- c) The Contractor must identify and provide all ITS equipment, materials and other works necessary to perform the tests required by this Master Specification Part.
- d) Where tests require a connection to TrafficNet, the Contractor must request that the Principal supply the connection.
- e) The Contractor must not cause ITS devices to show displays during the testing and commissioning process (for example, messages or speed limits) which may be visible to motorists without the prior approval of the Principal.

9.2 Testing and commissioning plans

- a) The Contractor must prepare Testing and Commissioning Management Plans relevant to the ITS equipment in accordance with the requirements of PC-CN1 "Testing and Commissioning" and PC-QA1 "Quality Management Requirements" or PC-QA2 "Quality Management Requirements for Major Projects" (as applicable). The Testing and Commissioning

Management Plans must be submitted to the Principal as part of the Construction Documentation.

- b) The Contractor must ensure that the Testing and Commissioning Management Plans:
 - i) take into consideration different traffic volumes and weather conditions where these may be reasonably expected to impact the performance or accuracy of the ITS equipment or system or affect the result of the testing or commissioning; and
 - ii) include details of resources to be provided by the Principal (for example, personnel, STREAMS site test application) to facilitate, assist with or witness testing. Timing for the provision of Principal resources must be agreed by the Principal.
- c) In addition to the requirements of section 9.2a), the Testing and Commissioning Management Plans must address, as a minimum:
 - i) IP connectivity;
 - ii) communications tests;
 - iii) electrical tests;
 - iv) required latency and bandwidth performance;
 - v) test equipment or system operation;
 - vi) STREAMS defined fault testing;
 - vii) compliance with this Master Specification Part; and
 - viii) maintenance tests, if the Contract Documents include maintenance.

9.3 Acceptance testing

9.3.1 General

- a) The Contractor must undertake acceptance testing on the ITS equipment in accordance with the Testing and Commissioning Management Plan approved pursuant to PC-CN1 "Testing and Commissioning", including the ITS equipment's interfaces with the TMC's computer systems including any BTMC.
- b) For the purposes of section 9.3.1a), the Contractor must ensure that:
 - i) test harnesses (including network load generation tools, simulations of field devices and simulations of sensor actuations) are only used where approved by the Principal as part of the testing and commissioning plan; and
 - ii) tests are conducted on ITS devices and equipment, including the communications network, in their final configuration, unless otherwise approved by the Principal as part of the testing and commissioning plan.
- c) The Contractor must submit the results of acceptance testing, including an acceptance test certificate, to the Principal as part of the Quality Management Records within 7 days of completion of acceptance testing.
- d) Test certificates for testing conducted progressively must be submitted within 7 days of completing the testing.
- e) The results submitted pursuant to section 9.3.1c) must include records of the actual performance of the ITS equipment with reference to the acceptable measure of performance defined by the acceptance testing requirements of the Testing and Commissioning Management Plan.

9.3.2 Factory Acceptance Testing (FAT)

- a) FAT must comply with the requirements of PC-CN1 "Testing and Commissioning".

- b) Prior to the commencement of FAT, the ITS devices or subsystem must be placed under formalised configuration management, with any changes to ITS equipment configurations, programming, firmware updates, or functionality being managed through an approved Configuration Management Plan. This applies to changes in the factory or on site post installation.

9.3.3 Factory Integration Acceptance Testing (FIAT)

- a) FIAT must verify that the interfaces between all devices are compliant with the requirements of PC-CN1 “Testing and Commissioning”.
- b) The testing must include;
 - i) all STREAMS field processors;
 - ii) all network switches;
 - iii) all servers;
 - iv) all CCTV cameras; and
 - v) sample sets of other ITS field devices and test equipment.

9.3.4 Post installation inspection and testing

Post installation inspection and testing must comply with the requirements of PC-CN1 “Testing and Commissioning”.

9.3.5 Device and control software module testing and commissioning

Device and control software module testing and commissioning must comply with the requirements of PC-CN1 “Testing and Commissioning”.

9.3.6 Site Acceptance Testing (SAT)

- a) SAT must comply with the requirements of PC-CN1 “Testing and Commissioning”.
- b) The Contractor must:
 - i) record site location and installation details of all ITS equipment undergoing SAT; and
 - ii) for sign or display type ITS equipment:
 - A. adjust and confirm sign mounting (tilt and alignment) to ensure the designed sight distance is achieved;
 - B. for lane specific equipment (such as LUMS), ensure that the equipment is aligned correctly for the lane which it applies to; and
 - C. ensure signs are unobscured by any co-located roadside furniture, other signage or trees.

9.3.7 System Integration Acceptance Testing (SIAT)

- a) SIAT must comply with the requirements of PC-CN1 “Testing and Commissioning”.
- b) The Contractor must ensure that the Testing and Commissioning Management Plan includes scheduling details for when a STREAMS operator is required to be provided by the Principal as may be required to complete SIAT.
- c) Where the installation and integration of ITS equipment includes PLCs or a PMCS, the Contractor must ensure that integration of the PLCs and PMCS with STREAMS is included as a part of the SIAT.
- d) The Contractor must undertake SIAT (including a sample of failure modes as approved by the Principal in the Testing and Commissioning Management Plan) to demonstrate that the ITS equipment and system functionality is achieved in the STREAMS test server.

- e) The Contractor must ensure that STREAMS field response or response plans execute correctly, proving the ITS devices and system functions as required by the Contract Documents.

9.3.8 Operational scenario testing

- a) OST must comply with the requirements of PC-CN1 “Testing and Commissioning”.
- b) The Contractor must ensure that the installed ITS equipment meets the requirements of the OST, including:
 - i) that incident detection input into STREAMS automatically generates appropriate responses on the field devices; and
 - ii) that full functionality of either response plans or the field response engine within STREAMS for road management is achieved.

9.3.9 User Acceptance Testing (UAT)

UAT must comply with the requirements of PC-CN1 “Testing and Commissioning”.

9.4 TrafficNet testing

- a) The Contractor must comply with the following cable testing and commissioning requirements as they pertain to TrafficNet:
 - i) for ports that will have equipment connected at Handover the Contractor must perform channel tests to class EA;
 - ii) the channel tests must include all patch cables (including those connected to equipment);
 - iii) once the channel tests have been successfully completed, those patch leads must not be relocated or replaced, or the channel tests will be invalidated;
 - iv) for all unused ports, the Contractor must perform permanent link tests to class EA; and
 - v) in the event a channel test or permanent link test failure, the Contractor must rectify the fault and repeat the test until an unconditional pass is achieved.
- b) The Contractor must ensure that:
 - i) optical fibre cables are tested in accordance with
 - A. International Telecommunication Union ITU-T G.650.3 Test methods for installed single-mode optical fibre links; and
 - B. the requirements of RD-ITS-C3 “Telecommunications Cabling”;
 - ii) copper telecommunications cables are testing in accordance with RD-ITS-C3 “Telecommunications Cabling”; and
 - iii) all connectivity between switches devices of the same type (e.g. switch-to-switch, router to router) must:
 - A. be made using network cross-over cables of suitable configuration; and
 - B. not rely on auto negotiation of cable pin outs.
- c) Full test records (including failures and re-testing after rectification) must be provided by the Contractor to the Principal prior to equipment commissioning or Handover. Provision of test records constitutes a **Hold Point**.

10 Fabrication and installation of support structures for ITS equipment

10.1 General

The Contractor must ensure that support structures required for the installation of ITS equipment comply with the following fabrication and installation requirements:

- a) support structures must be fabricated and installed in accordance with the requirements of:
 - i) RD-ITS-D1 "Design of Intelligent Transport Systems (ITS)";
 - ii) ST-SS-S1 "Fabrication of Structural Steelwork"; and
 - iii) RD-LM-D1 "Traffic Control Device Design";
- b) the minimum height above ground of the ITS equipment must be such as to prevent unauthorised access;
- c) wherever practicable, any electronic equipment which is sensitive to heat must be positioned and painted a suitable colour to minimise the effects of direct solar radiation;
- d) if the ITS equipment is to be mounted on an existing structure, the Contractor must verify the suitability of the structure and the mounting arrangement for support of the ITS equipment;
- e) grouting must:
 - i) be completed on the day of support structure or ITS equipment installation; and
 - ii) comply with specification ST-SC-S7 "Supply of Concrete";
- f) conduits must be rodded or roped and checked for usability after grouting;
- g) if cables are pre-installed in structures prior to installation on-site, the cables must be checked after grouting to be sure that they have not been grouted in-place;
- h) cables installed in ITS structure vertical risers must have catenary support; and
- i) structures must have access hatches to support easy cable installation and maintenance.

10.2 Support structures for electronic signs

The Contractor must ensure that support structures for electronic signs satisfy the following requirements:

- a) the mounting brackets for the signs must be incorporated in the design;
- b) the underside of signs must be:
 - i) at least 2.5 m above ground level; or
 - ii) such other height as specified in the Contract Documents;
- c) access for cable to the signs must be included in the design;
- d) the tilt angle and orientation of the signs must be designed to ensure that the line of sight is set at its optimum;
- e) the design of the sign support allows adjustment of the tilt angle and orientation after installation of the sign; and
- f) exterior metal surfaces of support structure brackets are treated with a durable finish that matches the support structure.

10.3 Gantries and major support structures

Shop Drawings for all gantries and major support structures required for the installation of ITS equipment must be submitted with Construction Documentation for approval by the Principal.

11 Handover

11.1 1,000 hours Defect free

- a) Notwithstanding that handover of operational control of the ITS may have occurred, the Contractor will remain responsible for all ITS infrastructure, and Completion will not be certified by the Principal, until the ITS has run continuously for 1,000 hours Defect free in accordance with the Department Completion Procedure For ITS Defect Free Period.
- b) The Contractor must submit evidence demonstrating the completion of the 1,000 hours Defect free period to the Principal for approval, which will constitute a **Hold Point**. The Defects Liability Period must not commence until the Hold Point is released.

11.2 Maintenance technician support

Where required by the Contract Documents, the Contractor must provide an ITS technician to support the Principal's nominated maintenance personnel for up to 3 months following the Date of Completion for the working times and contactable hours as described in the Contract Documents.

11.3 Records

As part of the Quality Management Records, the Contractor must provide to the Principal:

- a) As-Built Records for the ITS equipment, including asset database data sets as required by PC-EDM5 "Digital Engineering" and PC-CN2 "Asset Handover"; and
- b) technical data including manufacturer, model, hardware, firmware or software version of all ITS equipment.

11.4 Asset labelling

The Contractor must ensure that all ITS devices are labelled in accordance with the following:

- a) adhesive asset labels are attached to all ITS devices (labelled in accordance with Appendix 1: ITS equipment prefix and Appendix 2: Principal asset label template);
- b) asset labels:
 - i) are yellow quality retro-reflective type;
 - ii) use black print and clear gloss laminate;
 - iii) label material is 3M Scotchcal Electrocut fim series 7725-120 or equivalent; and
 - iv) adhesive backing is compliant with AS 1906.1 Retroreflective materials and devices for road traffic control purposes, Part 1: Retroreflective sheeting; and
- c) labels are affixed to each item of ITS equipment prior to, or immediately after installation.

11.5 Site documentation

- a) The Contractor must ensure that as a component of commissioning that all ITS and power cabinets and enclosures contain laminated detailed A3 drawings of:
 - i) the local road area serviced by the cabinet, including locations of every field device controlled by the cabinet, annotated with the Principal's asset identification;
 - ii) details of power supply to the cabinet, and from the cabinet to each device;
 - iii) details of communications to the cabinet, including spare fibre cores;

- iv) details of associated pits and conduits; and
 - v) cabinet internal layout, including power and communications reticulation.
- b) Where an ITS cabinet controls a small “single use” cabinet such as used for a CCTV camera which is remote from the main ITS cabinet and the documentation cannot be physically located within the small cabinet due to size constraints:
- i) the documentation required by section 11.5a) relating to the single use cabinet may be located at the main ITS cabinet: and
 - ii) a label is affixed to the interior of the door of the single use cabinet advising that the documentation is located at the main ITS cabinet.

12 Training

- a) In addition to the requirements of PC-CN2 “Asset Handover”, the Contractor must ensure that, for the purpose of ITS equipment, the Training Manual provides:
- i) an operations training plan; and
 - ii) a maintenance training plan,
- which addresses each type of installed ITS equipment.
- b) In addition to the requirements of PC-CN2 “Asset Handover”, the Contractor must provide operations and maintenance manuals relevant to each type of installed ITS equipment in accordance with RD-ITS-S1 “General Requirements for the Supply of ITS Equipment”.
- c) For the purposes of PC-CN2 “Asset Handover”, the Contractor must ensure that training is provided with respect to all installed ITS equipment in accordance with the following requirements:
- i) training must be provided to:
 - A. the Principal (or the Principal’s nominated representatives);
 - B. TMC operators; and
 - C. the Principal’s nominated maintenance technicians;
 - ii) the training must include details of the operation and maintenance of the installed ITS equipment;
 - iii) the operations training and the maintenance training must be provided separately due to the significant differences in training content;
 - iv) each relevant component of training must be provided:
 - A. as soon as practicable after the successful commissioning of individual items of ITS equipment and systems; and
 - B. no earlier than 7 Business Days after the relevant O&M Manuals have been provided to the Principal in accordance with PC-CN2 “Asset Handover”; and
 - v) the training must be provided in accordance with the Training Manual.
- d) Duplicated training sessions for both operations and maintenance staff must be provided by the Contractor on a number of separate occasions to allow for maintenance and operations staff to be rostered off active duties for the duration of the training courses:
- i) based on the content of each course;
 - ii) for up to 6 people at each training session;
 - iii) at the times, dates and locations directed by the Principal; and
 - iv) as required for each of the attendees nominated by the Principal to attend the training.

- e) The training must include the following:
 - i) an overview of the ITS equipment installation, including:
 - A. site familiarisation;
 - B. modes of operation;
 - C. device locations; and
 - D. safe access arrangements;
 - ii) the operation of each type of installed ITS equipment, including:
 - A. management of faults, failures and incidents;
 - B. diagnostic procedures and diagnosis of faults and repair; and
 - C. the replacement of faulty modules;
 - iii) a complete functional description of each item of ITS equipment;
 - iv) operations and operational capabilities of each item of installed ITS equipment;
 - v) failure mechanisms and repercussions for each item of installed ITS equipment;
 - vi) operational capabilities of systems related to the installed ITS equipment;
 - vii) how to safely access and perform routine maintenance on the installed ITS equipment and related systems;
 - viii) how to repair the installed ITS equipment and related systems;
 - ix) failure mechanisms and repercussions of systems related to the installed ITS equipment; and
 - x) structure and relevant contents of the manuals.

13 Warranty and spares

- a) The Contractor must ensure that warranties and spare parts for all installed ITS equipment is provided in accordance with the requirements of:
 - i) the Contract Documents; and
 - ii) RD-ITS-S1 “General Requirements for the Supply of ITS Equipment”.
- b) All ITS equipment warranty periods must commence at the completion of the 1,000 hours Defect free period required by section 11.1.
- c) The Contractor must ensure that warranties provided by the equipment supplier as required in RD-ITS-S1 “General Requirements for the Supply of ITS Equipment”:
 - i) are valid throughout any transport, storage, installation and commissioning processes;
 - ii) are transferred in full to the Principal;
 - iii) with conditions for ITS equipment are adhered to, including for:
 - A. transport;
 - B. storage;
 - C. installation and integration;
 - D. testing and commissioning; and
 - E. handover.

- d) The Contractor must submit details of warranty periods and a description of warranty claim procedures and conditions as part of the Quality Management Records.

14 Defects Liability Period - management of Defects

- a) The Defects Liability Period for installed ITS equipment must not start until the Hold Point required by section 11.1b) has been released.
- b) In the event of a Defect occurring with respect to an item of installed ITS equipment during the Defects Liability Period, the Contractor must provide the Principal with details on the course of action to be undertaken within 2 Business Days of notification of the Defect, and the expected timeframe before repairs will be complete.

15 Hold Points

Table RD-ITS-C1 15-1 details the review period or notification period, and type (documentation or construction quality) for each Hold Point referred to in this Master Specification Part.

Table RD-ITS-C1 15-1 Hold Points

Section reference	Hold Point	Documentation or construction quality	Review period or notification period
3.4h)	Approval of network equipment configuration	Documentation	20 Business Days review
3.5c)	Receipt of the core and distribution TrafficNet network equipment	Documentation	20 Business Days
9.4c)	Provision of TrafficNet test records	Documentation	10 Business Days.
11.1b)	Provision of evidence of achievement of 1,000 hours Defect free	Documentation	10 Business Days review

16 Appendix 1: ITS equipment prefix

In addition to the requirements of this Appendix 1: ITS equipment prefix, the Contractor must also comply with the asset numbering requirements set out in RD-ITS-D1 “Design of Intelligent Transport Systems (ITS)”.

Table RD-ITS-C1 16-1 ITS equipment prefixes

Device / equipment type	Equipment / label number
Advance warning sign	AWS###
Arrestor bed detector	ABD###
Automated pedestrian gates	PG###
Bluetooth station	BT###
Boom barrier	BB###
CCTV/Video incident detection camera/thermal incident detection camera	CAM###
Changeable message sign	CMS###
Closed circuit television camera	CAM###
Emergency signal	ES###
Fatality free day sign	FFS###
Generator	GEN###
Help phone (formerly emergency phone)	HLP###
Illuminated pavement lighting	PAL###
ITS cabinet (formerly outstation)	ITS###
Lane use management system	LUMS###
Outback road condition sign	RCS###
Over height detector	OHD###
Point to point camera	PPTC###
Power distribution board	PDB###
Radar detector	RAD###
Railway crossing active signage (excludes AWS)	RLX###
Ramp Control Sign - RC1	RC1###
Ramp Control Sign - RC2	RC2###
Ramp Control Sign - RC3	RC3###
Red lighting safety camera	RSC###
Safe-T-CAM / truck scan	STC###
Switchboard	SWB###
TIRTL detector	TLD###
Travel information sign	TIS###
Tunnel status sign	TSS###
Variable message sign	VMS###
Variable speed limit sign	VSS###
Weather detector	WED###
Wire rope monitoring system	WRMS###

17 Appendix 2: Principal asset label template

- a) There are 2 standard sizes for Principal asset stickers:
 - i) Large - including Principal asset number and Traffic Management Centre 1800 number, size 250 mm (H) x 300 mm (W); and
 - ii) Small - Principal asset number only, size 85 mm (H) x various width depending on the number of characters.
- b) Example of large format label size ITS574 @ 300 mm x 250 mm



- c) Example of small format label size CAM1031 @ 85 mm x 280 mm

