

Manual

**Traffic and Road Use Management
Volume 4 – Intelligent Transport Systems and Electrical Technology**

Part 7: Intelligent Transport Systems Maintenance

November 2015

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1 Introduction

The department is responsible for the provision, maintenance and management of the major arterial and linking roads and road transport infrastructure throughout Queensland. As part of this infrastructure, the department owns and maintains Intelligent Transport Systems (ITS) installations. These are an essential component of road safety infrastructure.

This is a new addition to the Traffic and Road Use Management (TRUM) Manual. It deals with the maintenance of ITS equipment, covering: Help phones, Vehicle detectors, Imaging equipment, Dynamic message signs, Automatic number plate recognition system, Weather stations, Communication network, Pump stations and ITS cabinets.

2 Scope

This document contains the minimum requirements for maintenance practices applicable to Intelligent Transport Systems (ITS) equipment that will allow these installations to continue operating safely, reliably, efficiently and effectively for the duration of their economic service life.

The Intelligent Transport Systems maintenance regime includes electrical, operational, structural and environmental aspects, covering both scheduled and unscheduled work.

The differences between the requirements of this document and TRUM Volume 4, Part 6: Periodic Verification Guide for Traffic Signals, Road Lights, and ITS Equipment Installations are the frequency and the tasks involved. Periodic verification is to satisfy the requirements of AS/NZS 3019 Electrical Installations – Periodic Verification and the *Electrical Safety Act 2002*, particularly to make sure that the installation is electrically safe, and is carried out every five years. The maintenance activities covered in this document may need to be carried out on a more regular basis than every five years, however the frequency depends upon budget constraints and end of life considerations.

Due to the vast array of ITS equipment types, models, variations, etc., it is not possible to define a standard testing regime to cover all ITS equipment. All testing on ITS equipment shall be in accordance with the manufacturer's recommendations and in accordance with associated legislation and standards.

3 Abbreviations

Abbreviation	Full title
AS/NZS	Australia & New Zealand Standard
DMS	Dynamic Message Sign
DVTEL	TMR Video Management System
ESO	Electrical Safety Office
EWP	Elevated Work Platform
GPS	Global Positioning System
IER	Immediate Electrical Risk
ITS	Intelligent Transport Systems

Abbreviation	Full title
KDU/HHT	Keyboard Display Unit/Hand Held Terminal
LGAQ	Local Government Association of Queensland
MRTS	Transport and Main Roads Specifications (available at http://www.tmr.qld.gov.au)
MUTCD	Manual of Uniform Traffic Control Devices (Queensland)
PLC	Programmable Logic Circuit
PTZ	Pan, tilt and zoom
RCD	Residual Current Device
RMPC	Road Maintenance Performance Contract
RSM	Road System Manager (State-wide Planning)
SIMS	STREAMS Incidence Management System
TMC	Traffic Management Centre

4 Definition of terms

Abbreviation	Full title
The Act	<i>Electrical Safety Act 2002</i> , Regulations and Codes of Practice
Current (non-electrical)	Current at the time of the maintenance activity
Electricity entity/works	As defined in The Act
Wiring Rules	AS/NZS 3000 commonly referred to as the Wiring Rules

5 General maintenance requirements

The ITS maintenance specification will mainly address the devices which the department has built up a bank of learnings on to extend and sweat the ITS assets as long as possible, whilst still keeping a reliable and fit for purpose ITS system.

5.1 Maintenance programs

Ownership of the ITS installation is to be confirmed before maintenance is undertaken.

The programming of maintenance activities for ITS equipment is the responsibility of the Regions/Districts and is generally carried out under the Road Maintenance Performance Contract (RMPC). Refer to Element Management Plan No. 34.

5.2 Applicable standards

Work is to be carried out in accordance with Transport and Main Roads specifications, AS/NZS 3019 Electrical Installations – Periodic Verification and the *Electrical Safety Act 2002*, Regulations and Codes of Practice (The Act). All works, processes and procedures used in maintenance activities associated with the electrical works described herein is to be in accordance with The Act. Electrical maintenance is not to be carried out live except as permitted under The Act.

The following are the key regulations and technical standards applicable to the departments ITS

equipment:

Electrical Safety Act	<i>Electrical Safety Act 2002</i>
Workplace	<i>Health and Safety Act 2011</i>
AS/NZS 3000	Wiring Rules
AS/NZS 3017	Electrical Installations – Verification Guidelines
AS/NZS 3019	Electrical Installations – Periodic Verification
TRUM Vol 4 Part 6	Periodic Verification Guide for Traffic Signals, Road Lights, and ITS Equipment Installations
MUTCD	<i>TMR Manual of Uniform Traffic Control Devices</i>
RPDM	<i>Road Planning and Design Manual</i>
MRTS70	<i>Concrete</i>
MRTS91	<i>Conduits and Pits</i>
MRTS201	<i>General Equipment Requirements</i>
MRTS202	<i>Variable Message Signs</i>
MRTS204	<i>Vehicle Detectors</i>
MRTS206	<i>Variable Speed Limit and Lane Control Signs</i>
MRTS221	<i>Help Phones</i>
MRTS225	<i>Imaging Equipment</i>
MRTS226	<i>Telecommunication Field Cabinets</i>
MRTS228	<i>Electrical Switchboards</i>
MRTS231	<i>Weather Monitors</i>
MRTS232	<i>Field Processors</i>
MRTS237	<i>Changeable Message Signs</i>
MRTS245	<i>Principal's Telecommunication Network</i>
MRTS250	<i>Automatic Number Plate Recognition System</i>
MRTS251	<i>Traffic Counter/Classifier</i>
MRTS256	<i>Power Cables</i>
MRTS257	<i>Vehicle Detector Loop Cables and Loop Feeder Cables</i>
Standard Drawings	Relevant TMR Standard Drawings

5.3 Installation drawings

Installation drawings are required for the safe maintenance of electrical installations. Regions/Districts are to work with the maintenance provider to ensure that electrical installation drawings are current and reflect the actual state of the installation. Where drawings are incorrect and/or non-existent, Regions/Districts are to arrange for accurate drawings to be produced. Drawings are to conform to the requirements of the Transport and Main Roads Drafting and Design Presentation Standards manual.

Where modifications or alterations are made to the installation as-constructed drawings and records of tests are to be provided.

5.4 Maintenance personnel

Personnel undertaking ITS maintenance activities (including the Superintendent's Representative) are to have the appropriate qualifications, training and experience necessary to undertake their designated activities in a safe and considered manner. These are to include working in a high speed road environment, knowledge of MUTCD Part 3 and relevant MRTS.

The possession of a valid Occupational Health and Safety Construction Induction card (also known as a 'White Card' or the previous 'Blue Card') and a current adult First Aid Certificate are also prerequisites for all persons working on ITS installations.

If the maintenance involved electrical equipment, they must be approved by the Electrical Safety Office (ESO) to work under the Department of Transport and Main Roads Electrical Contractors License (possession of a 'Green Card').

Appropriate training of personnel is the responsibility of the organisation providing the maintenance service. Regions/Districts are responsible for collecting this information from the service provider and are to undertake random audits to ensure compliance.

5.5 Maintenance plant and equipment

When maintaining ITS supporting structures such as mast arm installations, elevated work platform (EWP) vehicles are to be used. Every operator is to possess a valid EWP operator ticket, relevant driver's licence and is to have an appropriate level of experience in EWP operation. Operators are to have training in safe work procedures and evidence of such training. Regions/Districts are responsible for collecting this information from the service provider and are to undertake random audits to ensure compliance.

Vehicles are to have safety checks and have valid current certification in accordance with the relevant parts of:

AS 1418.10	Cranes, hoists and winches – Part 10 Elevated working platforms
AS 2550.10	Cranes, hoists and winches safe use – Part 10 Mobile elevated working platforms
AS 4748	Acoustic emission testing of fibreglass insulated booms on elevated work platforms

Equipment used for maintenance is to comply with relevant safety legislation and standards and be appropriate for the application. Testing equipment calibration is to be current with calibration evidence included in the maintenance report. Regions/Districts are to undertake random audits to ensure compliance.

5.6 Maintenance waste disposal

Disposal of waste and unserviceable equipment after it is removed from service must be undertaken in a safe and environmentally friendly manner.

5.7 Replacement parts

Replacement parts are to comply with current Transport and Main Roads Specifications.

The current rating and characteristics of electrical circuit protection devices are to be no greater than those specified on the Standard Drawings or manufacturer's documentation. Installations that do not comply with the requirements of The Act are to be rectified.

The photometrics, electrical and ingress protection characteristics of replacement aspects are to be such that the lighting and electrical integrity of the installation are not compromised.

5.8 Traffic management

Safety and traffic control plans where required are to be approved by the Region/District before maintenance work is conducted.

All signage used during maintenance is to be in accordance with Part 3 of the *Manual of Uniform Traffic Control Devices* (MUTCD).

5.9 Reporting requirements

The progress of any maintenance regime being undertaken is to be tracked and reported. Regular maintenance meetings are to be scheduled between the maintenance service provider and the Region/District.

The meetings are to cover as a minimum the following items:

- review of performance of the ITS hardware
- review of performance of the ITS service provider
- reporting of current progress against expected – for example staffing levels/changes, budgeting/expenditure, and
- discussion of issues/problems and how they are being addressed.

Regions/Districts are to inform the Director (ITS and Electrical) about any systemic issues.

5.10 Record keeping

All ITS verification activities are to be logged to monitor performance and to trend failure and outage rates. Data to be collected are defined in Appendix A and Appendix B.

Minimum details required to be logged and reported include:

- site number
- name of road and/or road number
- region/district number
- date installation commissioned or date manufactured
- type of maintenance service – damage/fault, replacement of parts, routine spot, etc.
- item maintained – pit, post, lens, camera, switchboard, lamps, etc.
- part(s) replacement date
- verification process carried out
- name of maintenance service provider (Contractor company name and maintenance personnel)
- date maintained.

Where applicable, the ITS and Electrical “Road Operations Asset Maintenance System” (ROAMS) is to be used.

In the next revision this document will be updated to include electronic data collection and report via ROAMS, together with the other two documents on the maintenance of Traffic Signals and Road Lighting installations.

6 Preventative maintenance

6.1 Electrical

Electrical tests are to be carried out and documented in accordance with the Wiring Rules and AS/NZS 3019: Electrical Installations – Periodic Verification, and in accordance with TRUM Volume 4, Part 6: Periodic Verification Guide for Traffic Signals, Road Lights, and ITS Equipment Installations. Periodic inspections and tests are required on the electrical installation to ensure compliance with The Act. Full inspections and tests are to be carried out at a maximum of five yearly intervals. Where the risk of degradation of the installation due to environmental or other factors is considered high, more frequent inspections are to be carried out. Spot check audits on parts of high risk installations are to be carried out at a maximum of 12 month intervals. Typical high risk factors may include: corrosive environments, susceptibility to flood/submergence, devices nearing end of life, vermin habitats and high pedestrian activity.

Immediate electrical risks (including exposed live conductors, unearthed equipment and incorrect polarity) must be made safe and rectified when discovered and the ESO and Region/District Management notified.

6.1.1 Point of supply maintenance

The ITS equipment is supplied from the electricity entity’s network. Supply can typically be from:

- overhead pole mounted transformer with fuse
- underground pit with fuse
- pillar/post box with fuse from an underground supply.

Verification is to include a visual inspection of the point of supply for signs of degradation. Where there is any concern about the integrity of the point of supply or the upstream network, the electricity entity is to be advised.

Work is not to be carried out on electricity entity infrastructure without the express written permission of the electricity entity.

6.1.2 Electrical switchboard maintenance

Maintenance is to be carried out to ensure the electrical integrity of the switchboard. As the switchboard is the point where the ITS equipment is connected to the supply, it is important that all the components are in good condition.

Inspection is to include but not be limited to:

- ingress of water and vermin
- deterioration of weatherproof seals and other components

- damage by vermin
- detection of poor connections and joints
- correct earthing
- protection against direct and indirect contact with LV terminals/surfaces
- correct internal labelling of components
- correct labelling of field cables.

6.1.3 Cable and connection maintenance

Electrical cabling and connections are to be maintained to ensure a low impedance path for the electricity supply. While the cable is expected to last in excess of 25 years under standard operating conditions, a number of factors (such as those mentioned above) can reduce service life. Consequently, visual observations and electrical tests are required regularly.

Where cable temperatures are significantly raised due to poor electrical connections, insulation damage can occur, which may ultimately result in fire. Clean cable termination surfaces, correct fixing tightness and the application of protecting grease to terminations can assist in maintaining the integrity of the termination. Thermal imaging equipment can be used where practical and cost effective to aid early detection of high resistance joints.

Transport and Main Roads Specifications now specify the use of either XLPE/PVC or XLPE/HDPE mains cabling for new installations. PVC/PVC cabling is not designed to be submersed in water for periods of time. The new standard cables are more resilient. Where there is a known water retention problem, the better quality XLPE/HDPE cable should be used to replace PVC/PVC cables that have reached end of life.

Rodent and vermin attack as well as poor installation methods can also affect the integrity of the cable sheath. Where damage has occurred, moisture ingress and cable degradation will occur.

Where the rate of insulation resistance degradation reasonably suggests that the cable insulation will not comply at the next regular inspection interval, inspection frequency is to be increased or rectification undertaken.

Inspection items are to include but not be limited to:

- joints, connections and terminations for corrosion
- poor, loose, overheated or unsecured connections
- evidence of moisture ingress to cables and/ or connections
- damaged insulation
- exposed conductors
- general condition of cable
- evidence of rodent/vermin activity
- devices that are not fixed wired are to be tested and tagged
- carbon, soot build-up.

In accordance with the Wiring Rules, electrical tests are to be carried out on cables and results documented.

6.1.4 Pits and conduit maintenance

Pits and conduits are to be inspected visually. Once it has been determined that the conduit installation complies with the required depth, this need no longer be checked except where work to the ground surface has been carried out in the vicinity of the conduit.

Pit lids are to be intact, undamaged and properly fitted to the pit. Pits are to be free of damage, with no collapse of ground around the pit, no collapse of the inside of the pit, and with the pit top level with the surrounding surface. Pits are to be free draining.

Maintenance of pits and conduits is to include but not be limited to:

- ensuring adequate drainage
- replacement of broken or chipped pit lids
- rectifying collapsed pit side walls and other damage
- maintaining ground/pit surface level and pit surrounds.

Cement pits and ducts that contain, or are suspected to contain, asbestos materials are to be handled using safe work practices and qualified persons in accordance with workplace health and safety legislation and Transport and Main Roads procedures. All asbestos materials are to be identified and recorded in Region/District registers.

6.2 ITS equipment

ITS maintenance activities are quite varied and really depends on the type of device and associated manufacturer recommendations as to the most appropriate maintenance activities to be conducted or whether reactive, or preventative scheduled maintenance is required.

Regular inspections and servicing are required on the ITS installation to ensure it is operating safely and efficiently as designed.

Routine ITS maintenance is to include, but not be limited to:

- checking equipment for correct alignment and rectifying as required
- checking equipment for damage, blown lamps, LEDs, damaged lenses and rectifying as required
- checking all ITS equipment are functioning correctly, and replacing as necessary
- ensuring site identifier is clearly legible and clean or replace as required
- clearing fault and error log in equipment cabinets after the above work is complete
- check operation of STREAMS connection.

Due to the vast array of ITS equipment types, models, variations, etc., it is not possible to define a standard testing regime to cover all ITS equipment. All testing on ITS equipment shall be in accordance with the manufacturer's recommendations and in accordance with associated legislation and standards.

6.2.1 Help phone maintenance

The following operations shall be included as part of this activity:

- physically inspect phones for damage
- clean and inspect telephone signage
- remedy any damage to original installation condition
- test phone is operational by calling the Traffic Management Centre
- confirm phone can callout and ringer works; and
- ensure phone hang up mechanism is working correctly.

The telephone installation shall be tested in accordance with the applicable requirements of MRTS201.

6.2.2 Inductive loops maintenance

The following operations shall be included as part of this activity:

- loop feeder labelling
- confirm loop feeder termination cable tension; and
- check LEDs are working with triggers.

If any damage sustained to departmental inductive loops is identified as a consequence of activities by third parties (i.e. road profiling, kerb alteration works), all reasonable steps shall be taken to assist the department with the identification of the contractor(s) involved.

The principal will contact the project which caused damage to the loops where possible to arrange for them to repair the loops as required.

Testing requirements:

1. onsite testing verifying confirmation of functionality of loop inductance and continuity
2. verification of detector operation in consultation with the Principal within STREAMS
3. the inductive loop installation shall be tested in accordance with the applicable requirements of MRTS204, MRTS257 and MRTS201.

6.2.3 Vehicle detector site maintenance

The maintenance of vehicle detector site shall include the maintenance of the following assets:

- vehicle detection sites
- ramp metering sites
- bluetooth sites
- piezo classification equipment
- vehicle detection's hardware and software
- power supply (ELV) and cables
- power supply (LV) and cables
- communication cables, and

- sub mains (pillar / post / cabinet).

Testing Requirements

1. onsite testing verifying confirmation of functionality of vehicle detection site and on STREAMS
2. the vehicle detector installation shall be tested in accordance with the applicable clauses of MRTS204, MRTS257 and MRTS201.

6.2.4 Imaging equipment maintenance

The maintenance and the configuration cover the following departmental assets:

Camera including PTZ and Video Connections:

- web cameras
- power supply (ELV) and cables
- power supply (LV) and cables
- communication cables (serial / ethernet)
- sub-mains (pillar / post / cabinet), and
- video encoders.

The following operations shall be included as part of this activity:

- clean camera and lens
- inspect camera mounting bracket for leakage, tension and corrosion including fall arrest
- check cable tension
- check camera operation in DVTEL
- replacement of any parts as required, and
- liaise with the Traffic Management Centre to ensure the camera is operational as per requirements.

Testing Requirements

1. onsite testing verifying confirmation of functionality of image equipment
2. the Imaging equipment installation shall be tested in accordance with Clause 10 of MRTS225.

6.2.5 Dynamic message signs maintenance

The maintenance of the departments dynamic message signs covers the following assets:

- Changeable Message Signs (CMS)
- Variable Message Signs (VMS)
- Variable Speed Limit Signs (VSLS)
- Lane Use Management Signs (LUMS)
- Bus Message Signs (BMS)
- Vehicle Activated Signs VAS)
- power supply (ELV) and cables

- power supply (LV) and cables
- communication cables, and
- sub mains (pillar / post / cabinet).

The following operations shall be included as part of this activity:

- check for failed pixels (dead pixels and permanently-on pixels)
- run maintenance software, carry out all checks and verify results visually on the sign display e.g. LED intensities
- check sign operation and associated equipment
- clean viewing window
- check and clean micro-filters
- check access ladder lock
- check prism stop alignment and adjust if required (CMS only), and
- replacement of any parts as required.

Testing Requirements

1. onsite testing verifying confirmation of functionality of dynamic message signs and on STREAMS
2. the dynamic message sign installation shall be tested in accordance with the applicable element of MRTS201.

6.2.6 Automatic number plate recognition system maintenance

The maintenance of the departments automatic number plate recognition system shall cover the following assets:

- side mounted pole supports
- camera units and mounting brackets
- processor
- wiring and cabling
- conduit network, and
- field cabinets.

The following operations shall be included as part of this activity:

- cleaning of all lenses and housings and confirming all devices are properly secured, and
- run test modules to determine whether data is received within acceptable error levels
- replacement of any parts as required.

Testing Requirements

The Automatic Number Plate Recognition installation shall be tested in accordance with the applicable element of MRTS201.

6.2.7 Weather station maintenance

The maintenance of weather stations in accordance with the published maintenance manuals includes the following activities:

- weather Stations
- station's hardware and software
- power supply (ELV) and cables
- power supply (LV) and cables
- communication cables (serial / ethernet), and
- sub mains (pillar / post / cabinet).

The following operations shall be included as part of this activity:

- check wind speed and direction sensors turn freely
- check rain gauge unit is free from obstruction and bucket tips freely
- check flash rate of "system running" light
- arrange recalibrate by specialised technicians, if require, and
- replacement of any parts as required.

Testing Requirements

1. onsite testing verifying confirmation of functionality of weather station and on STREAMS
2. the weather station installation shall be tested in accordance with the applicable element of MRTS201.

6.2.8 Communication network maintenance

The maintenance of the departments communication network shall include the maintenance of the following assets:

- power supply (ELV) and cables
- power supply (LV) and cables
- communication copper and optical fibre network cables including FOBOTS
- point to point microwave link
- sub mains (pillar / post / cabinet)
- layer-2 network switches (with default network configuration by the department)
- Traffic signal controller cables
- surge protection
- layer-3 network switches (with default network configuration by the department) upon request
- field processors (with default network configuration by the department)
- Telstra network termination units (NTU), and
- ramp metering PLC's.

The following operations shall be included as part of this activity:

- clean and check that all Field Processor connectors are seated and clean
- check patch cable connections and cable tray and replace if damaged, and
- check the operational of communication network by visually inspecting switches and other communications equipment, and
- replacement of any parts as required.

Testing Requirements

1. onsite testing verifying confirmation of functionality of communication network site and on STREAMS
2. the communication network installation shall be tested in accordance with the applicable element of MRTS201.

6.2.9 Routine ITS Cabinet Inspections

One fifth of the District ITS Cabinets shall be inspected each year. The five year plan on the maintenance of all ITS Cabinets within the District shall be submitted to the District manager by the 1st of July of the first financial year.

The routine servicing of the following equipment is included in this activity:

- CCTV sites
- vehicle detector sites
- weather Station sites
- generators
- UPS
- power supply (ELV) and cables
- power supply (LV) and cables
- communication cables
- sub mains (pillar / cabinet)
- DMS sites, and
- communications network cabinets.

Testing Requirements

As specified in Operational Inspection on ITS Cabinets template supplied in Appendix C.

6.2.10 Pump station maintenance

The maintenance of the departments pump stations shall be performed in accordance with the published maintenance manuals and shall cover the following assets:

- electrical switchboard and cables
- equipment hardware and software
- water pumps

- diesel generator
- emergency lighting
- compound lighting
- communication cables (Serial), and
- structure of pump station.

6.3 Structural

Periodic visual inspections are to be undertaken to ensure at least the following items are examined for compliance with the relevant standards:

- steel posts
- other equipment supports (for example, secured to structures).

Inspections are to be carried out ten years after original installation and then every five years thereafter. Environmental conditions to which the ITS installation is subject may require the frequency of inspections to be increased - for example, bridges/overpasses, corrosive environment and areas prone to flooding.

Structural inspections are to be completed in accordance with Structures Branch requirements.

6.3.1 Steel post maintenance

Where steel posts are damaged, degraded, or corroded, they are to be replaced.

6.3.2 Gantries maintenance

Maintenance of large supporting structures like gantries is covered under Element 39 and under the responsibilities of Structures Branch.

6.4 Environmental

The maximum interval between inspections is 12 months. Where particularly detrimental environmental conditions require – for example, corrosive environment and areas prone to flooding – more frequent inspections are to be carried out.

6.4.1 Vegetation management

The growth of vegetation near ITS equipment has the potential to significantly reduce the effectiveness of the ITS installations. Where vegetation or other obstructions have, or may have an impact on ITS performance, they are to be removed or otherwise treated to remove the deficiency/risk.

Vegetation may increase the likelihood of vermin and/or hinder access to switchgear and electrical pits and is to be managed accordingly. Concrete surrounds should be installed around equipment, particularly switchboards.

6.4.2 Vermin

Evidence of vermin infestation is to be removed, and damage caused by vermin is to be rectified. The installation is to be treated/modified to prevent/minimise the likelihood of reinfestation.

6.4.3 Maintenance access

Where necessary, access to sites is to be remedied to allow safe, all-weather access by maintenance personnel.

6.4.4 General tidy up

Each site is to be cleaned of all waste/rubbish so as to present a clean, tidy area that reflects well on Transport and Main Roads.

6.4.5 Cleaning and painting

The ITS equipment and associated hardware are to be cleaned and posters and graffiti removed. Where paintwork is damaged or has deteriorated, it is to be repainted.

Appendix A: ITS inventory

The following inventory information is to be maintained.

ITS equipment**Inventory on electrical switchboard**

Region:				
Switchboard ID:				
Description:				
Road No.:		LGA No.:		Job No.:
Road Name:				Suburb:
Latitude:		Longitude:		
Plan No.:		Plan Rev.:		Rev. Date:

Inventory

Item	Value			
Switchboard type:	<input type="checkbox"/> Main	<input type="checkbox"/> Submain	Main switchboard ID:	
Size of consumer mains (mm²):	<input type="checkbox"/> 10	<input type="checkbox"/> 16	<input type="checkbox"/> 20	<input type="checkbox"/> 25 <input type="checkbox"/> 35
Type of consumer mains cable:	<input type="checkbox"/> V75	<input type="checkbox"/> V90	<input type="checkbox"/> XLPE	
Distance from LV terminals/source (m):	<input type="checkbox"/> within 10 m	<input type="checkbox"/> within 100 m	<input type="checkbox"/> within 500 m	
	<input type="checkbox"/> within 50 m	<input type="checkbox"/> within 200 m	<input type="checkbox"/> greater than 500 m	
Main switch type:	<input type="checkbox"/> Fuse	<input type="checkbox"/> Isolator	<input type="checkbox"/> MCB	Size: <input type="checkbox"/> 63A <input type="checkbox"/> 80A
No. of circuits:				
No. of spaces for additional circuits:				
No. of phases:	<input type="checkbox"/> Single phase	<input type="checkbox"/> 2 phase	<input type="checkbox"/> 3 phase	
Photocell type:	<input type="checkbox"/> NEMA	<input type="checkbox"/> Other		
Photocell location:	<input type="checkbox"/> 4.1 m post	<input type="checkbox"/> Power pole	<input type="checkbox"/> Other	
Housing/cabinet type:	<input type="checkbox"/> Pillar box	<input type="checkbox"/> Ground cabinet	<input type="checkbox"/> Post Top mounted	
Type of earth:	<input type="checkbox"/> Common earth	<input type="checkbox"/> MEN		
Location of MEN point:	<input type="checkbox"/> Switchboard	<input type="checkbox"/> Distribution board		
Type of earth electrode:	<input type="checkbox"/> Pole footing	<input type="checkbox"/> Earth stake	Size:	<input type="checkbox"/> 12 mm <input type="checkbox"/> 16 mm

ITS Equipment**Inventory on electrical switchboard**

Current status with respect to the last audit/inspection:	<input type="checkbox"/> Last audit/inspection outcomes not yet reviewed to determine remedial works <input type="checkbox"/> No work required from last audit/inspection <input type="checkbox"/> Decommissioned <input type="checkbox"/> Design phase <input type="checkbox"/> Tender phase <input type="checkbox"/> Construction phase <input type="checkbox"/> Remedial works certified and completed.
Additional comments:	
Inspector name:	
Inspector signature:	
Inspection date:	

ITS Equipment**Inventory on circuits and cables**

Region:					
Switchboard ID:					
Description:					
Circuit ID:					
Description:					
Road No.:		LGA No.:		Job No.:	
Road name:				Suburb:	
Latitude:		Longitude:			
Plan No.:		Plan Rev.:		Rev. date:	

Inventory

Item	Value					
Circuit/cable protection type:	<input type="checkbox"/> HRC Fuse	<input type="checkbox"/> MCB B	<input type="checkbox"/> MCB C	<input type="checkbox"/> Contractor		
Size (A):	<input type="checkbox"/> 10	<input type="checkbox"/> 16	<input type="checkbox"/> 20	<input type="checkbox"/> 25	<input type="checkbox"/> 32	
Cable protection configuration (phase):	<input type="checkbox"/> Single phase	<input type="checkbox"/> 2 phase	<input type="checkbox"/> 3 phase			
Cable type:	<input type="checkbox"/> V75	<input type="checkbox"/> V90	<input type="checkbox"/> XLPE			
Cable configuration:	<input type="checkbox"/> SDI	<input type="checkbox"/> Multicore	<input type="checkbox"/> Circular	<input type="checkbox"/> Flat		
No. of cores:	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5		
Active conductor size (mm²):	<input type="checkbox"/> 4	<input type="checkbox"/> 6	<input type="checkbox"/> 10	<input type="checkbox"/> 16	<input type="checkbox"/> 25	<input type="checkbox"/> 35
Earth size (mm²):	<input type="checkbox"/> 4	<input type="checkbox"/> 6	<input type="checkbox"/> 10	<input type="checkbox"/> 16	<input type="checkbox"/> 25	<input type="checkbox"/> 35
Pole guard type:	<input type="checkbox"/> None	<input type="checkbox"/> Steel	<input type="checkbox"/> Timber	<input type="checkbox"/> Steel earthed	<input type="checkbox"/> Plastic	

ITS Equipment

Inventory on circuits and cables

Current status with respect to the last audit/inspection:	<input type="checkbox"/> Last audit/ inspection outcomes not yet reviewed to determine remedial works <input type="checkbox"/> No work required from last audit/inspection <input type="checkbox"/> Decommissioned <input type="checkbox"/> Design phase <input type="checkbox"/> Tender phase <input type="checkbox"/> Construction phase <input type="checkbox"/> Remedial works certified and completed
Additional comments:	
Inspector name:	
Inspector signature:	
Inspector date:	

ITS Equipment**Inventory on supporting structure**

Region:					
Switchboard ID:					
Description:					
Road No.:		LGA No.:		Job No.:	
Road name:				Suburb:	
Latitude:		Longitude:			
Plan No.:		Plan Rev.:		Rev. date:	

Inventory

Item	Description

Current status with respect to the last audit/inspection:	<input type="checkbox"/> Last audit/inspection outcomes not yet reviewed to determine remedial works <input type="checkbox"/> No work required from last audit/inspection <input type="checkbox"/> Decommissioned <input type="checkbox"/> Design phase <input type="checkbox"/> Tender phase <input type="checkbox"/> Construction phase <input type="checkbox"/> Remedial works certified and completed
Additional comments:	
Inspector name:	
Inspector signature:	
Inspector date:	

ITS Equipment**Inventory on ITS equipment**

Region:					
Switchboard ID:					
Description:					
Road No.:		LGA No.:		Job No.:	
Road name:				Suburb:	
Latitude:		Longitude:			
Plan No.:		Plan Rev.:		Rev. date:	

Inventory (as per manufacture list)

Item	Description

Current status with respect to the last audit/inspection:	<input type="checkbox"/> Last audit/inspection outcomes not yet reviewed to determine remedial works <input type="checkbox"/> No work required from last audit/inspection <input type="checkbox"/> Decommissioned <input type="checkbox"/> Design phase <input type="checkbox"/> Tender phase <input type="checkbox"/> Construction phase <input type="checkbox"/> Remedial works certified and completed
Additional comments:	
Inspector name:	
Inspector signature:	
Inspector date:	

Appendix B: ITS Equipment Maintenance Reports

The following inspection reports are to be produced:

ITS Equipment**Inspection on electrical switchboard**

Region:					
Switchboard ID:					
Description:					
Road No.:		LGA No.:		Job No.:	
Road name:				Suburb:	
Latitude:		Longitude:			
Plan No.:		Plan Rev.:		Rev. date:	

Inventory

Item	Pass	Fail			Corrective Action Required
		IER	AS	MRTS	
Safe location	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Safe access (present and future)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Pole guard	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Seal against vermin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Protection against direct contact	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Signs of degradation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Main switch labelled	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Protection devices labelled	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
MEN link	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Earth conductor/clamp/stake	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Neutral link	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Photocell (operation, orientation, fixture, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Drawing/conduit schedule correct	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Submain connection correct	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Exposed conductors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Unearthed equipment (including all metallic fixtures)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Suitable IP rating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

ITS Equipment**Inspection on electrical switchboard****Tests**

Item	Value	Pass	Fail			Corrective Action Required
			IER	AS	MRTS	
Main earth conductor resistance (Ohm)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Insulation resistance (MOhm)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Earth Fault Loop Impedance (Ohm) (External EFLI into supply)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Polarity		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Maximum Demand (A)	N/A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Voltage (V)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Additional comments:	
Inspector name:	
Inspector signature:	
Inspection date:	

ITS Equipment**Inspection on circuits and cables**

Region:					
Switchboard ID:					
Description:					
Circuit ID:					
Description:					
Road No.:		LGA No.:		Job No.:	
Road name:				Suburb:	
Latitude:		Longitude:			
Plan No.:		Plan Rev.:		Rev. date:	

Inspections

Item	Pass	Fail			Corrective Action Required
		IER	AS	MRTS	
Correctly terminated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Correctly labelled	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Correct colour coding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Signs of degradation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Cable protection type/size	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Drawing correct	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Correct circuit connections	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Tests

Item	Value	Pass	Fail			Corrective Action Required
			IER	AS	MRTS	
Insulation resistance (MOhm)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Earth fault loop impedance (Ohm)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Full load current		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Polarity	N/A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

ITS Equipment**Inspection on circuits and cables**

Additional comments:	
Inspector name:	
Inspector signature:	
Inspection date:	

ITS Equipment**Inspection on supporting structure**

Region:					
Switchboard ID:					
Description:					
Road No.:		LGA No.:		Job No.:	
Road name:				Suburb:	
Latitude:		Longitude:			
Plan No.:		Plan Rev.:		Rev. date:	

Inspections

Item	Comments / Corrective Action Required

Additional comments:	
Inspector name:	
Inspector signature:	
Inspection date:	

ITS Equipment**Inspection on ITS equipment**

Region:					
Switchboard ID:					
Description:					
Road No.:		LGA No.:		Job No.:	
Road name:				Suburb:	
Latitude:		Longitude:			
Plan No.:		Plan Rev.:		Rev. date:	

Inspections (As per manufacture list)

Item	Comments / Corrective Action Required

Additional comments:	
Inspector name:	
Inspector signature:	
Inspection date:	

Appendix C: Operational Inspection of ITS Cabinets

Region/District:			
Cabinet No.:			
Road No.:		LGA No.:	Job No.:
Road name:			Suburb:
Operational Inspection			
Inspect	Yes/No (if NO, please fill in columns to the left)	Corrective action required? (in your own words)	Action taken
Is the cabinet shell OK?			
Are all cabinet door locks functional?			
Are all door hinges OK?			
Is the cabinet labelled externally?			
Are the conduits entering the cabinet sealed?			
Is the cabinet chassis earthed via the electrical system earth link?			
Is there compliant electrical separation to communications equipment?			
Has RCD protection been removed from the circuits powering ITS equipment?			
Does the RCD on the socket outlet test OK?			
Are there appropriate surge protection devices installed?			
Is the surge protection operational?			
Are the thermostats set to 35oC?			
Do the fans come on when the thermostat is adjusted manually towards the minimum temperature?			
Are the door seals in good condition and creating a good seal?			
Is there any equipment that is not being used? If so remove it and record what it was in the action taken column			
ACTION - Vacuum inside cabinet			
ACTION - Clean/Replace filters			
ACTION - Remove any disused equipment			

Inspect	Yes/No (If NO, please fill in columns to the left)	Corrective action required? (in your own words)	Action taken
Vehicle Counting Site: Rack type:			
Are all loops functioning correctly?			
Do the loops correspond with the plan?			
Are the loops sealed in the pavement?			
Are the loop feeder cables numbered in the cabinet?			
Are the loop feeder cable screens earthed?			
Pits at Cabinet			
Are all associated pit lids intact?			
Are all associated pits in reasonable condition?			
Are spreaders in place where there is provision for them?			
Inspected by:			
Comments:			

