

Roads

Master Specification

RD-EL-D1 Road Lighting Design

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Document Management

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Contents

Contents	3
RD-EL-D1 Road Lighting Design	4
1 Introduction	4
2 Design Development – General Information	4
3 Responsibilities	5
4 Drawings	5
5 Lighting Operational Performance	6
6 Lighting Conduits	7
7 Lighting Pits Location and Type	7
8 Lighting Poles	8
9 Electrical Requirements	9
10 Smart Lighting Management System	11
11 Luminaires	12
12 Tunnel and Underpass Lighting	12
13 Records	12
14 Hold Points	13
15 Appendix 1: Road Lighting Instructional Drawing	14

RD-EL-D1 Road Lighting Design

1 Introduction

- 1.1 This Design Standard specifies the requirements for undertaking the design and documentation of road lighting systems and associated electrical infrastructure on Department roads. It does not cover the design of the lighting of public transport interchanges, railway stations and railway infrastructure.

2 Design Development – General Information

- 2.1 The design will comply with:
- a) Electricity Act 1996 (SA).
 - b) Electricity (General) Regulations 2012 (SA).
 - c) SA Power Networks: Service Rules and Regulations.
 - d) AS/NZS 1158 Lighting - Roads and Public Spaces.
 - e) AS/NZS 4282 Control of the Obtrusive Effects of Outdoor Lighting (applicable to lighting adjacent to residential properties)
 - f) AS/NZS 3000 Electrical Installations.
 - g) AS/NZS 3008.1 Electrical Installation - Cable Selection.
 - h) AS/NZS 3845.2 Road Safety Barrier Systems and Devices Part 2 Road Safety Devices.
 - i) Austroads Publication: Guide to Road Design Part 6B: Roadside Environment.
 - j) CASA (Civil Aviation Safety Authority) Airport Lighting Exclusion Zones.
 - k) Department Operational Instruction 20.25 “Energy Management for Electrical Assets”, available from <https://www.dit.sa.gov.au/standards/tass>.
 - l) RD-EL-D3 “A Guide to Conduit Design for Road Lighting, Traffic Signals and ITS”.
 - m) Clearances specified by the Office of the Technical Regulator (OTR): Building Safely Near Powerlines and Working Safely Near Powerline, available from:
 - i) https://www.sa.gov.au/_data/assets/pdf_file/0003/18606/150513-Building-safely-near-powerlines-web.pdf; and
 - ii) http://www.sa.gov.au/_data/assets/pdf_file/0003/6969/160708-Working-safely-near-overhead-powerlines.pdf.
 - n) Department Technical Standards and Guidelines including above drawings, which are available from the following web site: <https://www.dit.sa.gov.au/standards>.
- 2.2 Where this Part specifies a higher standard than that required by the above Australian Standards, the requirements of this Part will take precedence.
- 2.3 For unmetered supplies refer to Australian Energy Market Operator (AEMO) National Electricity Market Load Tables for Unmetered Connection Points.
- 2.4 All lighting design will be approved by the Department before the commencement of construction.

3 Responsibilities

Designer's Responsibilities

- 3.1 The person/organisation undertaking the design ("Designer") shall:
- a) liaise with relevant Department staff;
 - b) source asset numbers from the Department;
 - c) arrange Bracket Checks and Swing and Sag calculation with SAPN where required;
 - d) determine suitable Service Point location in accordance with SAPN rules where required; and
 - e) complete the checklist "Design Report Electrical Services", available from <https://www.dit.sa.gov.au/standards/roads-all> under the heading "Road Design".

Department Responsibilities

- 3.2 Technical Services is responsible for:
- a) providing lighting design advice and direction to Project Managers and external Designers that have been engaged to perform Lighting Designs;
 - b) reviewing and signing off for the compliance of the design with AS/NZS1158 and Department Standards and Guidelines;
 - c) nominating the road category, e.g. V or P; and
 - d) management of Standards and Specifications.
- 3.3 Road Network Maintenance, Operational Asset Planning, is responsible for:
- a) providing lighting asset management advice;
 - b) liaising with SAPN for tariff amendments and requests;
 - c) supplying asset number allocations for poles, luminaires and switchboards; and
 - d) reviewing Standards and Specifications.
- 3.4 Road Network Maintenance, Delivery is responsible for:
- a) providing Lighting and Electrical advice regarding compliance, constructability and maintainability of the installation;
 - b) assisting contractors and designers with site investigations when required;
 - c) site acceptance inspection at completion; and
 - d) reviewing Standards and Specifications.

4 Drawings

- 4.1 Drawings and other documentation will comply with the requirements specified in <https://www.dit.sa.gov.au/standards/roads-all>, specifically DP001, DP002, and DP013.
- 4.2 This Design Standard references Instructional Drawing which are in Appendix 1: Sh101 Road Lighting Instructional Drawing, e.g. Refer Sh101:1a refers to Sheet 101, instructional note 1a.
- 4.3 Lighting drawings will substantially follow the layout shown in the Instructional Drawing in Appendix 1: Road Lighting Instructional Drawing.
- 4.4 Table RD-EL-D1 4-1 contains some common issues and resolutions.

Table RD-EL-D1 4-1 Common issues and resolutions

Issue	Resolution
Drawing tables, Lighting Details, Legends may not all fit on appropriate sheets	If required these tables can be put onto a separate sheet with appropriate references
Conduit runs where multiple different infrastructure (e.g. ITS TS RL) is being fed	CST (Common Services Trench) with a cross-section or proposed services layout can be shown

5 Lighting Operational Performance

Design Technical Requirements

- 5.1 Unless otherwise specified, the lighting design will:
- illuminate Department infrastructure to the agreed category as per AS/NZS 1158;
 - minimise the “whole of life” costs to the Department (i.e. take into account the cost of construction, maintenance, repairs, energy consumption and replacement);
 - be appropriate for the site specific circumstances;
 - minimise the effect of obtrusive light on adjacent residencies as per AS/NZS 4282; and
 - take into account Work Health and Safety requirements for installation and ongoing maintenance.
- 5.2 Unless otherwise specified, existing SAPN Stobie poles can be used for mounting switchboards and luminaires, subject to bracket checks for suitability of proposed mounting height and outreach.
- 5.3 Stobie poles which are no longer used for power distribution will not be used for provision of new road lighting.
- 5.4 Wherever practicable, the design will avoid:
- placement of poles directly under powerlines;
 - interference with other services and structures (e.g. verandas);
 - property crossovers (e.g. driveways);
 - obscuring traffic signals and signage; and
 - placing poles within close proximity to the turning path of heavy vehicles.
- 5.5 The design will ensure that road lighting poles, bases, luminaires, conduits, pits and associated components comply with Department Master Specifications <https://www.dit.sa.gov.au/standards>.

Drawing Examples

- 5.6 If design information is unable to fit on a drawing, indicate which drawing and sheet the information resides on.
- 5.7 Where known, existing (E) and proposed changes to installation will be shown.
- 5.8 Where a Department project and design includes SAPN amendments, SAPN specific standards may be applied.
- 5.9 Where a Department project and design includes SAPN amendments, specific SAPN notes will be added to the Department drawing.
- 5.10 Refer Sh101:1a: Circuit Designators specify the luminaire, switchboard, phase and circuit numbers feeding the luminaire. A single circuit number is used for single phase installations (e.g. 1, 2, 3, 4.) whereas an R, W or B with the circuit designator number after it indicates three phase

installations (e.g. R1, R2, W1, W2, B1, B2.etc.). (Note: Stobie pole luminaires are directly connected, so no circuit numbers are required. The circuit designator will specify 'SAPN'). Where a combination Lighting and Signal pole is fed from a Signal Controller, the circuit designator will specify "SC").

- 5.11 Refer Sh101:1b: Where a Stobie mounted switchboard is used, a switchboard symbol will be shown adjacent to the service point and an earth stake pit will be placed greater than 3.5 m but within 5 m from SA Power Networks LV or HV earthing system or pole.
- 5.12 Refer Sh101:3a: SA Power Networks is responsible for providing bracket check information. This is then stored by the Department, and SAPN drawing number is shown on the Lighting Details table (e.g. Exxxx).
- 5.13 Refer Sh101:3b: Shows a luminaire mounted on a SAPN pole, indicating height and outreach details in metres.
- 5.14 Refer Sh101:1c Clearance to reticulated overhead and underground AC supplies will be as specified by the Office of the Technical Regulator requirements.
- 5.15 Refer Sh101:1d: Luminaire numbering needs to make logical sense. Left to right, top to bottom. At intersections, number Luminaire Light poles clockwise from north.
- 5.16 Refer Sh101:2a: Shall consult with the Department before using non-Department Standard Luminaires and Poles. Current approved Luminaire list can be found here: https://www.dit.sa.gov.au/_data/assets/pdf_file/0012/330105/Approved_Products_List.pdf.
- 5.17 Refer Sh101:2b: Delete any unused items in the legend so as to minimize sheet clutter.
- 5.18 Refer Sh101:1e: Removal crosses will be shown on any equipment to be removed and/or replaced. E.g. Department Luminaire, SAPN Luminaire, Department pole base, etc.

6 Lighting Conduits

- 6.1 Refer to RD-EL-D3 Conduit Design for Road Lighting, Traffic Signals and ITS.

Drawings Examples – Conduits

- 6.2 The designation for Road Lighting conduits will indicate quantity, size and purpose e.g. 2x80RL.
- 6.3 Cross section profile of Common Services Trenches will be shown on the drawing.
- 6.4 Where Road Lighting conduits cross a road, a spare conduit will be installed.
- 6.5 Refer Sh101:1f: Unless otherwise specified, underground road lighting conduits will be 80mm. Stobie pole riser from SAPN fuse box to 1st pit conduit will be 50mm.

7 Lighting Pits Location and Type

- 7.1 Refer to RD-EL-D3 Conduit Design for Road Lighting, Traffic Signals and ITS.

Drawing Examples

- 7.2 A P4 pit is required either side of a road crossing. For un-kerbed roads, a secure metal lid pit will be used.
- 7.3 Typically P4 pits are used as per Table RD-EL-D3 7-1 Nominal Pit Size Guide in RD-EL-D3 "Conduit Design of Road Lighting, Traffic Signals and ITS" (Pit legend blocks will be sourced from the Department standard CAD support files on <https://www.dit.sa.gov.au/standards>)
- 7.4 Spacing between pits will be as per RD-EL-D3 Conduit Design for Road Lighting, Traffic Signals and ITS.

- 7.5 Refer Sh101:1g: Where a Combination Lighting/Traffic Signals pole is used a P4 pit needs to be installed adjacent/behind the pole. The exception to this is where a Combination pole is within 4m of a D, S or P4 pit.

8 Lighting Poles

Technical Requirements

- 8.1 Poles and luminaires will be aligned linearly where possible (differing kerb styles may need special consideration). Department pole outreaches will be aligned perpendicular to the road.
- 8.2 Designers shall consider the relative risks to motorists and pedestrians for the specific design, when selecting energy absorbing or slip base poles. Slip base poles will be used exclusively except within 20m on the approach side to a bus stop and in areas of high pedestrian activity (as defined in AS/NZS 1158) where the speed limit is 50 km/h or lower. In these locations, energy absorbing poles will be used. In locations where either slip base or energy absorbing poles may present a hazard, the Department's Principal Engineer, Lighting, will be consulted to make an appropriate determination.
- 8.3 Combination traffic signal/road lighting poles, including mast arms, will be used at traffic signal sites to minimise the number of poles around an intersection. Where combination traffic signal/road lighting poles are installed in ELV traffic signal intersection, dual Voltage 240V AC and 42V AC voltages present stickers will be installed to the opening of the door of the Combination Pole.
- 8.4 Unless otherwise specified, poles will be 10.5 m or 12.0 m high with single or dual 3.0 m or 4.5 m outreaches.
- 8.5 At roundabouts with a centre island diameter greater than 8 m, a 4-way outreach on a 12 m high pole may be considered if technical parameters of AS/NZS1158 are satisfied.
- 8.6 Where it is proposed to use light poles or outreaches that are not currently approved for use by the Department, details of maintenance requirements, crash testing compliance and the process of purchasing replacements will be provided in accordance with RD-EL-S1. The Department is under no obligation to accept unapproved light poles or outreaches.
- 8.7 Poles will be located so that the level of lighting is not compromised by any existing or proposed trees or structures.
- 8.8 New pole locations will not conflict with other services, trees or property crossovers and will be located to avoid conflict with traffic signal line-of-sight requirements. In the event of service conflicts, the Contractor is required to review the Department Standard Lighting drawings for details of possible alternative pole footing designs. Clearances from hazardous areas will be in accordance with AS/NZS 60079.10.1 or Office of the Technical Regulator (OTR) requirements.
- 8.9 Pole setback and placement will be in accordance with AS/NZS1158.
- 8.10 Road lighting poles may only be installed in centre medians where the median has a minimum width of 2.0 m. Poles will be set back at least 1.0 m from the face of kerb.
- 8.11 Road lighting poles will not be located in front of traffic and pedestrian barriers. Where poles are installed behind non rigid barriers, allowances will be made for the deflection of the barrier on impact.
- 8.12 In instances where road lighting is in the vicinity of airports the height and placement of light poles will comply with CASA requirements.

Drawing Examples

- 8.13 Refer Sh101:1g: Where road lighting occurs at signalised intersections, designers shall use combination traffic signal/road lighting poles so as to minimise road furniture at the intersection.

- 8.14 Refer Sh101:1h: Pole setbacks will be as per AS/NZS1158, and set back correctly according to the relevant speed zones. A typical example for a 60 km/h kerbed road will be 0.7m minimum, whereas from the tangent point around corners this increases to 1.0 m. Refer to AS/NZS1158 for roads with higher speeds.
- 8.15 Refer Sh101:1i: For signalised intersections combination lighting and signal poles will generally be considered in the primary signal pole location.
- 8.16 Refer Sh101:3c: Lighting details table will provide reference to a '3D string' for pole location and orientation. Typical poles orientation will be aligned with the centre line of the road (not the kerb).
- 8.17 Refer Sh101:3d: Department Operational Asset Planning, Road Network Maintenance allocates Luminaire numbers and switchboards numbers for installations and adjusts ongoing tariffs requirements for the Department.
- 8.18 For multiple outreach poles, the luminaires will be numbered XXXXa, XXXXb, XXXXc and XXXXd where XXXX is the pole number.

9 Electrical Requirements

General Requirements

- 9.1 This section relates to the general electrical requirements associated with road lighting.

Technical Requirements

- 9.2 Electrical dimensioning needs to be considered for all circuits and sub circuits including any sub-mains feeds associated with the design. This will include any other circuits that may not be included in the design scope but fed off the common distribution point. It will include Circuit Current (I), Voltage drop (V Drop) and Fault Loop Impedance Calculations (Z loop).

Distribution

- 9.3 Electrical supplies to Department Lighting will be by one of the following methods:
- a) SAPN Stobie pole dedicated service fuse on the pole;
 - b) SAPN Underground/Green Top distribution pillar;
 - c) Direct connect;
 - d) Stobie mounted Road Lighting switchboard as per drawing 4055 sheet 55;
 - e) Ground mounted Road Lighting Type 'A' switchboard;
 - f) Signal Controller extension housing as per Clause 9.15 in the case of combination Lighting/Signal poles; and
 - g) Submersible Switchboard.

Clearance to Electrical Cables

- 9.4 Clearances of new lighting poles to overhead and underground electrical cables (including Transport related distribution cables) will comply with the OTR and Department requirements. In the event that the design fails to comply with minimum clearances, the Designer shall obtain the written approval of the OTR and the Department to use non complying clearances prior to proceeding with the Final Design. Consideration will be given to swing and sag calculations where required, and safe work installations using cranes (if required).
- 9.5 Aerial and underground cabling will be identified as Low Voltage (LV) or High Voltage (HV). Reference to any swing and sag calculations will be shown on the drawing.

- 9.6 The Department prefers a working clearance of 6 m. If this cannot be achieved, then a working clearance in accordance with the Office of the Technical Regulators documents 'Working Safely near Overhead Powerlines' and 'Building Safely near Powerlines' with the use of a spotter will be permissible
- 9.7 The Contractor shall provide a copy of any OTR approval(s) and calculations with the Final Design drawings.

Cable Selection

- 9.8 Electric distribution cable will be sheathed multi-strand copper core with V-90 thermoplastic or X-90 XLPE insulation. Cables will be rated for underground use and comply with AS/NZS3000 and AS/NZS 3008 requirements for distribution circuits. Active and Neutral distribution cables will be single, double-insulated (SDI) and have cross sectional areas between 6 mm² and 16 mm² unless otherwise specified. Earth cables will be single insulated, green/yellow and minimum 6mm² unless they are bundled with other conductors in a multicore cable.
- 9.9 Consumer main and sub-main supply cable will be sheathed multi-strand copper core with V-90 thermoplastic or X-90 XLPE insulation. Supply cable conductor cross sectional area will be a minimum of 16 mm² and will comply with AS/NZS3000 and AS/NZS 3008 requirements for distribution circuits.

Switchboards

- 9.10 Unmetered road lighting switchboard enclosures may be submersible, ground mounted or Stobie pole mounted. Metered road lighting switchboards will be ground mounted.
- 9.11 Department standard switchboard drawings are available from: <https://www.dit.sa.gov.au/standards/roads-all>, under the heading "Road Lighting" - Drawing 4055, Sheets 43, 54-58; 73.
- 9.12 For new installations, Type C Circuit Breakers will be used for distribution sub-circuits.
- 9.13 Unless otherwise approved, ground mounted switchboard enclosures will be positioned as far from the road as practical and where possible, beyond the clear zone for the respective road sections as outlined in Austroads Road Design guidelines. If possible, preference will be given to the door opening away from the road for the safety of maintenance personnel.
- 9.14 Dual purpose switchboards located at signalised intersections may be used to supply the Traffic Signal Controllers (through an isolation pit) and the Road Lighting distribution.
- 9.15 Road Lighting luminaires installed on combined traffic signal poles will be supplied and controlled from a Traffic Signal Controller extension housing non-essential distribution. Where one does not currently exist, an extension housing cabinet will be retro-fitted to the existing traffic signal controller. This is not applicable to pedestrian and koala crossings, where the luminaire(s) may be fed from a dedicated circuit breaker within the Signal Controller.
- 9.16 For upgraded Lighting installations, "Green top/fibreglass/plastic" Electrical Distribution Pillars will be replaced with a Department Type A switchboard.
- 9.17 Any equipment not on the Australian Energy Market Operator (AEMO) load tables (refer to https://www.aemo.com.au/-/media/Files/Electricity/NEM/Retail_and_Metering/Metering-Procedures/NEM-Load-Tables-For-Unmetered-Connection-Points.pdf) will be connected via a metered supply.

Poles

- 9.18 Circuit breakers in lighting poles will be double-pole 6A Type C, except when the luminaires are fed directly from a PE cell in the switch board in which case it will be double-pole 4A Type C.

Power Supply

- 9.19 The Designer shall determine the power supply points and reticulation in conjunction with SA Power Networks and obtain its written confirmation of the approval of the supply point.
- 9.20 Department pits supplying Consumer Mains to a Department distribution switchboard will be equipped with secure lids.
- 9.21 Where 3 phase distribution circuits are used, they will be balanced as closely as possible.
- 9.22 Because of the way the circuits are wired in 3 phase installations Vdrop and Zloop calculations need to be performed as a single phase calculation.

10 Smart Lighting Management System

- 10.1 The Smart Lighting Management System will provide the following features:
- a) monitoring, control, reporting and mapping functionality;
 - b) Revert to pre-set programme or integral PE cell control in the event of communications failure;
 - c) remote control and addressing of individual or groups of lights (e.g. by switchboard, individual, group of circuits). Allow for switching and/or dimming lights to a lower sub-category based on the programmed daily/weekly settings for each day of the year, daily, weekly and/or event based on site specific conditions including real-time traffic usage, monitored site lighting levels or other factors such as temporary site works;
 - d) hold current and historical log of asset information for each luminaire and associated equipment, e.g. switchboard including: asset number, GPS location, luminaire model, type, wattage, install date, pole number, outreach size, drawing number, meter number, site lighting level, status (on/off/failure/maintenance/decommissioned), load energy, voltage, current, temperature, etc.;
 - e) incorporate instantaneous monitoring, recording and displaying logs and graphs of the status of each luminaire including failure, loss of communications, energy use, voltage, current, temperature, etc.;
 - f) capable of automatically generating notifications to pre-defined or customized user groups via mobile application push notification, text message (SMS) and/or email;
 - g) storing all system and user activities related to the assets and be capable of searching, generating standard and custom reports for individual or selected groups of assets for current or selected time periods. Capability to exporting reports in a range of accepted industry formats including TXT, CSV, KML (Google Earth, Maps etc), KMZ and PDF;
 - h) web based user interface with both table and map views of individual or groups of selected assets or the entire system and clearly displaying selected asset attributes and status information;
 - i) incorporate comprehensive security access based on system administrator, user groups, with password access for each user-id; and
 - j) be TALQ compliant and capable of being integrated with other industry standard road lighting management systems.
- 10.2 Details of the Smart Lighting Management System will constitute a **Hold Point**.

11 Luminaires

General Requirements

- 11.1 Unless otherwise specified, LED luminaires in accordance with RD-EL-S2 "Supply of Luminaires" and on the Department's approved products list will be used.
- 11.2 Mounting heights for road lighting luminaires will be either 10.5m or 12m, in accordance with AS/NZS1158 1.2 Table 8.1, unless constrained by overhead cables or otherwise specified.
- 11.3 Luminaire mounting heights on Stobie poles may vary between 7 m and 12 m. Actual mounting height will be determined by SAPN.
- 11.4 LED luminaire will be mounted horizontally and have an upcast angle of 08 for Department and SAPN poles.
- 11.5 The maintenance factor for LED luminaires will be 0.8.

Drawings Examples

- 11.6 Luminaires located on other drawing sheets (than where the circuit details reside) need to be identified on the Circuit Details table.
- 11.7 Refer Sh101:1j: Luminaires, poles and SAPN overhead cable which are to be removed, will be indicated with cross symbols.

12 Tunnel and Underpass Lighting

- 12.1 Tunnel and underpass lighting will comply with AS/NZS1158 part 5.
- 12.2 Tunnel lighting control systems will be compatible with existing Department tunnel lighting control systems unless otherwise specified.
- 12.3 The Designer shall specify the appropriate TU lighting category(s) and reasons for the determination based on the structural characteristics, Table 2.1 and Clause 2.4 of the above Australian Standard.

13 Records

- 13.1 The Designer shall prepare and provide the following records. The provision of the following records will constitute a **Hold Point**.

Drawings

- 13.2 The design drawings in accordance with Department Design Presentation Standards, in particular "DP001 – General requirements", DP002 "Title and Index", and "DP013 Lighting".
- 13.3 Updated lighting and conduit drawings. As-constructed drawing will be supplied upon completion of lighting installation.

Reports

- 13.4 A report detailing compliance with AS/NZS1158, providing:
 - a) all calculations, including details of the lighting design program used to prepare the calculations;
 - b) Maintenance Factor used in the design;
 - c) power system, volt drop and fault loop impedance calculations;

- d) pole spacing calculations required for straight road sections; and
- e) Isolux contour drawing for the road and surrounding area with the relevant illuminance levels shown.
- f) Straight road spacing calculations

13.5 Department Lighting and Signals Presentation and Technical check list.

Implementation Records

13.6 Copy of any OTR clearance approval.

13.7 SA Power Networks “pole bracket check” and “cable swing and sag calculations”.

13.8 SA Power Networks supply point availability.

14 Hold Points

14.1 The following is a summary of Hold Points for the documents referenced in this Part:

Table RD-EL-D1 14-1 Hold Points

Document Ref.	Hold Point	Response Time
13.1	The submission of design records	15 Working Days

15 Appendix 1: Road Lighting Instructional Drawing

- 15.1 Road Lighting instructional drawing Sh101 is attached to show practical application of design considerations as specified above.
- 15.2 The drawing shows typical installations that can apply to Road Lighting drawings and designs.
- 15.3 In the legend, only items relevant to the design will be shown on that sheet.

