JUDGES CAR PARK, PENRITH – OBTRUSIVE LIGHTING REPORT

8 JUNE 2018

LAM CONSULTING ENGINEER

Attention: Allan Lam

RE: JUDGES CAR PARK, PENRITH – OBTRUSIVE LIGHTING REPORT

We have reviewed and conducted site survey lighting based on As Installed Drawings provided by Council and DA drawings of Proposed Development provided by Morson Group on 10th May 2018 and 1st June 2018.

The report has been evaluated and analysed in accordance with the requirements of AS/NZS 4282 -1997 *Control of the obtrusive effects of outdoor lighting* to the recommendation of Light Technical Parameter at boundary of commercial and residential areas.

Should you have any questions on this matter please do not hesitate to contact the undersigned at this office.

Yours faithfully,
Bow Jaruwangsanti – MIES

Creative Lighting Designer

bow@designbybow.com.au

Attachment: (1) Obtrusive Lighting report

Judges Car Park, Penrith – Obtrusive Lighting
Lighting Assessment Report June 2018

Table of Contents

1. INTRODUCTION

1.1 BACKGROUND

1.1.1 Design By Bow (DBB) has been appointed by Lam Consulting Engineer to complete a Obtrusive Lighting Assessment in support of the full planning application to Penrith Council for the new mixed use development on the existing land at the corner of Union Lane and Woodriff Street.

APPLICATION SITE

1.1.2 The Application Site is located to the east of Judges Car Park in Penrith. The application site comprises 7 levels including Basement B1 & B2 for parking, Mixed use of Commercial and Residential areas on Ground Floor and more Residential areas on Level 1 – Level 7.

1.1.3 Surrounding the Application Site to the North is Union Lane and Commercial buildings.

1.1.4 A plan showing the yellow area is the Application Site.

1.2 PURPOSE OF THIS REPORT

1.2.1 This report provides an assessment of the potential obtrusive effects of the headlights and outdoor lighting on the roof top of Judges Car Park that may occur on the proposed development.

1.2.2 The Lighting Assessment will:

- identify potential existing obtrusive light from the roof top level of Judge Car Park;
- describe potential effects on sensitive receptors as a result of obtrusive light from the roof top carpark to proposed development;
- set out details of the lighting strategy which includes measures to minimize obtrusive light;
- review proposed landscape plan of the proposed development relevant to obtrusive light.

2. Policy Context

The policy context relevant to the assessment of obtrusive light is summarised in this section, a detailed overview of the policy context is provided in **Appendix A**.

2.1 AUSTRALIAN STANDARD

2.1.1 Australian Standard AS4282 – 1997: Control of the obtrusive effects of outdoor lighting, further detail is provided in **Appendix A**.

2.1.2 We have classified the area type in accordance with AS 4282 - 1997 as at boundary of commercial and residential areas. (Refer to Table 2.1 in AS4282 in **Appendix A**)

2.1.3 According to clause 2.6 from AS 4282-1997, effects on residents generally involve a perceived change in amenity arising from the illumination from Spill Light being obtrusive and the direct view of bright luminaires from normal viewing directions causing annoyance, distraction or even discomfort. The tolerable levels of each of these light technical parameters will be influenced by the ambient lighting existing in that environment. This will be determined largely by the degree and type of the development of the area and by the road lighting in place. Further details is provided in **Appendix A.**

3. Methodology

This section provides an outline of methods and procedures undertaken in producing the lighting assessment including how the baseline lighting conditions were determined, and the assessment process undertaken.

3.1 BASELINE CONDITIONS

DESK BASED INFORMATION

3.1.1 A desktop review of the Judges Car Park and New Development Site has been undertaken to identify potential light sensitivity receptor.

3.1.2 The following sources of publically available information were reviewed:

- Google Street View
- Aerial Photography

Location of light poles

3.1.3 Although the desk based information enables a framework to be established for the assessment, the aerial photography and Google Street View are not sufficient as being definitive. A site walkover has therefore been undertaken to inform and ground truth the baseline lighting conditions.

SITE WALKOVER

3.1.4 The site walkover was undertaken on Monday 5th of June 2018 to identify existing lighting at the roof top of Judges Car Park. Daytime photographs were taken to show existing light poles and daylight. A night time walkover was undertaken to observe existing ambient light conditions and obtrusive light along the eastern boundary of the carpark.

3.2 ASSESSMENT

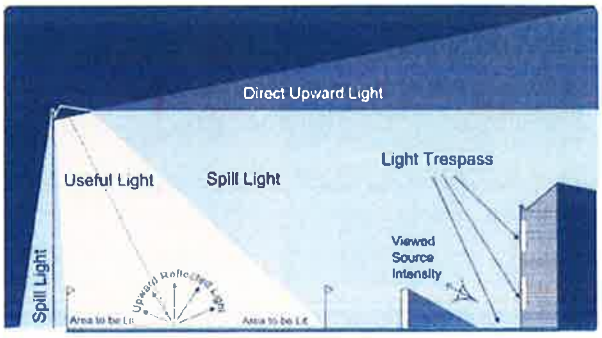
3.2.1 An assessment has been based on the lighting operating only during the pre-curfew hours. The operating hours of this carpark is between 6am-10pm. The assessment has been completed to establish the possible effects of obtrusive light that may arise once the proposed development is completed. This includes the consideration of potential adverse effects of the following three components of obtrusive light.

- **Illuminance in Vertical Plane or Spill Light (lux) –** when light affects the area beyond the boundary of the area which is to be lit. This is also known as "spill" or "trespass" and may cause nuisance or disturbance to sensitive receptors. (See **Figure 3-1**)

- **Luminous Intensity or Glare (cd)** – the brightness of a light source which is uncomfortable when viewed against a dark background. This is mostly experienced when light source are not covered by a shield or directed by a suitable lens / reflector set up.

- **Threshold Increment or Disability Glare (TI)** – the measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present.

Figure 3-1: Diagram



3.2.2 Spill light is the first factor of concerns. It is measured or calculated in a vertical plane. In this case, as the new development is not yet built, we will have to calculate illuminance values from AGI32 software (For the recommended maximum illuminance values refer to Table 2.1 from AS4282 in **Appendix A**)

- During pre-curfewed hours, this factor limits apply at relevant boundaries of nearby residential properties, in a vertical plane parallel to the relevant boundary, to a height commensurate with the height of the potentially affected dwellings.

- During curfewed, this factor limits apply in the plane of the windows of habitable rooms of dwellings on nearby residential properties, to a height commensurate with land use zoning provisions.

3.2.3 The second factor is concerned with glare from luminaire. This factor is assessed in terms of units of light intensity called candelas. This factor is difficult to assess and requires analysis of the photometric distribution of light from the luminaires.

- During pre-curfewed hours, this factor limits apply to each lumianaire in the installation. The maximum intensity is to be checked in the principal vertical plane, for all angles at and above the control direction, when aimed in accordance with installation. The maximum luminous intensity values are subjected to the level of glare control. There are two levels of pre-curfewed luminous intensity glare control. For this carpark, it is in a sensitive area and Level 1 control would typically apply to outdoor carparks and requires the use of low glare full cut-off lumianires with horizontal lens. The Judge Car Park is the area where is larger than 25 metres across, the maximum luminous intensity for this area is 7500cd for pre-curfewed hours. (Refer to Table 2.2 in AS 4282 in **Appendix A**)

- During curfewed hours, the luminous intensity from the subject luminaire should be determined in directions in which views of the bright surfaces of the luminaire are likely to be troublesome to residents. At the boundary of commercial and residential areas, the maximum luminous intensity is 2500cd. (Refer to Table 2.1 in AS 4282 in **Appendix A**

3.2.4 The final factor is threshold increment. This factor limits only apply to users of transport system, e.g., where lighting is near road, railway, waterway and air transport etc.

4 . Site Analysis

4.1 SITE SURVEY

4.1.1 We have measured location of light poles in order to obtain as built dimensions for use in the AGI32 Calculation. Measurement provided in **Appendix B**

4.2 Existing Outdoor Luminaires

4.2.1 We have observed two types of existing outdoor luminaires on the roof top parking and the ramp on the Eastern side of the building where the boundary is. First one is post top light and the second one is wall mounted batten light above the ramp. According to As Install Drawings provided by Council, the post top luminaire is from KIM Lighting part number CCL525, lamp is unknown. The wall mounted luminaire is unknown. (See **Photo 4-1**)

Photo 4.1

4.3 Vertical Illuminance Measurement On Site

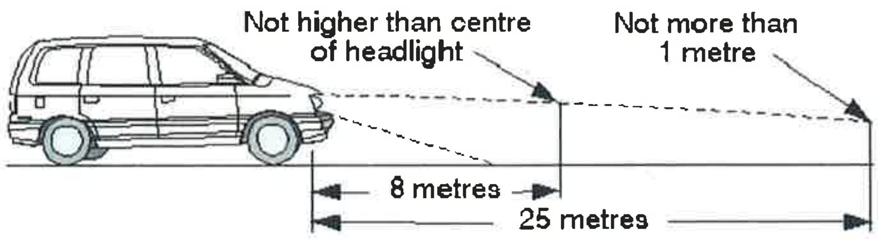
4.3.1 We observed some spill light on the trees which is created from post top luminaires near the boundary, (See **Photo 4-2**) The Vertical Illuminance (Spill Light) has been measured on site along the property boundary between carpark and new development. Layout and lux measurement is provided in **Appendix C**.

Photo 4-2: Spill lights on the trees along the boundary

4.4 Car Headlight Intrusion

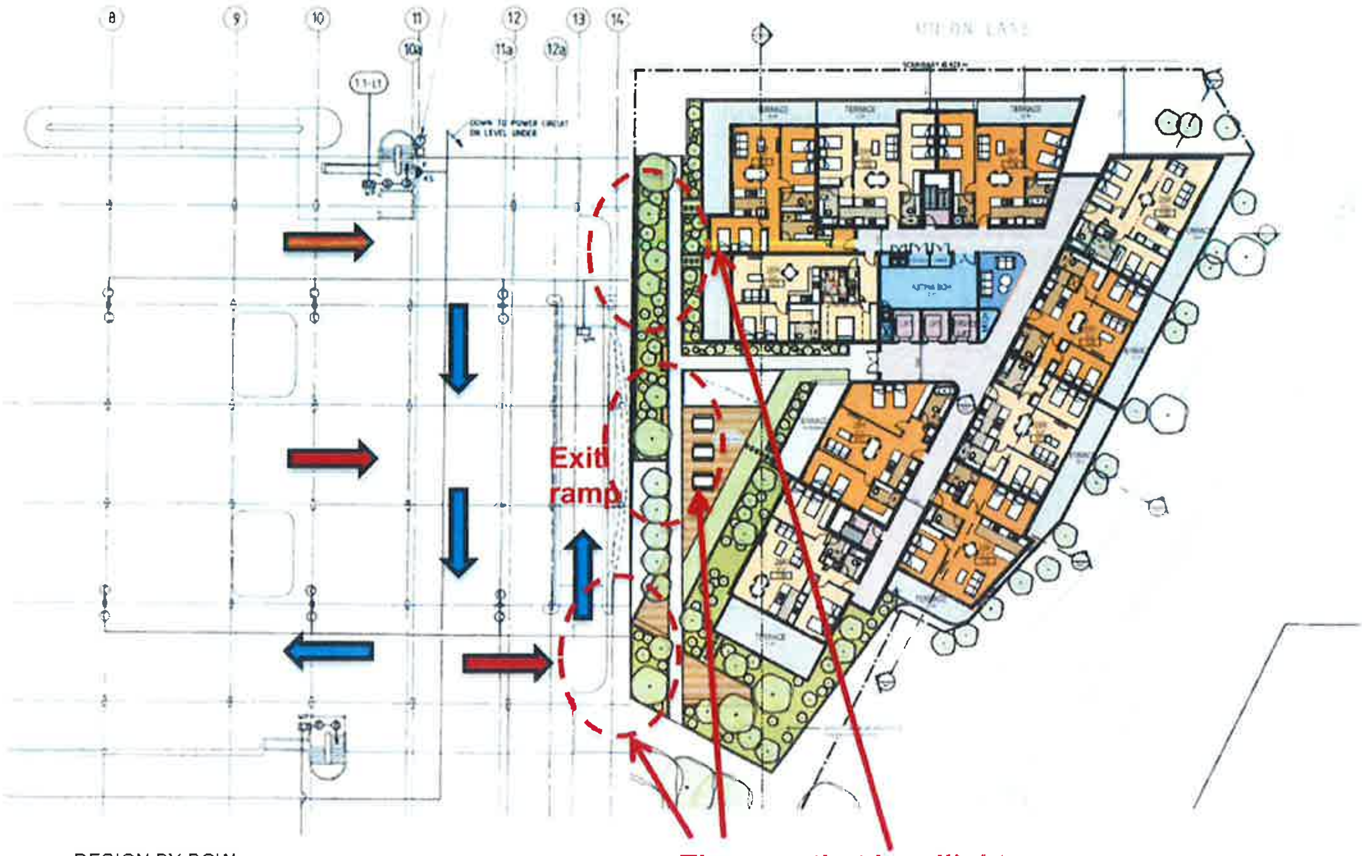
4.4.1 It is known that car headlights is uncontrollable source of illuminance as it is depending on the aiming adjustment of headlight from each car manufacturer. However, it is stated in Vehicle Standard (Australian Design Rule 46/00 Headlamps) 2006 and Australian Vehicle Standards Road Transport Reform Act 1999 about the photometric requirements for headlamps which will provide adequate illumination for the driver of the vehicle without producing undue glare for other road users. (See **Figure 4-1**)

Figure 4-1: Diagram showing headlight adjustment (low beam) from Australian Vehicle Standards Road Transport Reform Act 1999



4.4.2 See **Figure 4-1** for vehicle circulation on the roof top level. The exit ramp is next to the property boundary. Red arrow indicates the headlights pointing toward the proposed development.

Figure 4-1: Vehicle circulation on roof top carpark



4.4.3 The experiment has been taken on site with three different size of cars approaching to the exit ramp. The maximum intensity of the light beam from headlight most likely hit the concrete balustrade. (See **Photo 4-3, 4-4 and 4-5**)

Photo 4-3: Small car approached the exit ramp

Photo 4-4: Medium car approached the exit ramp

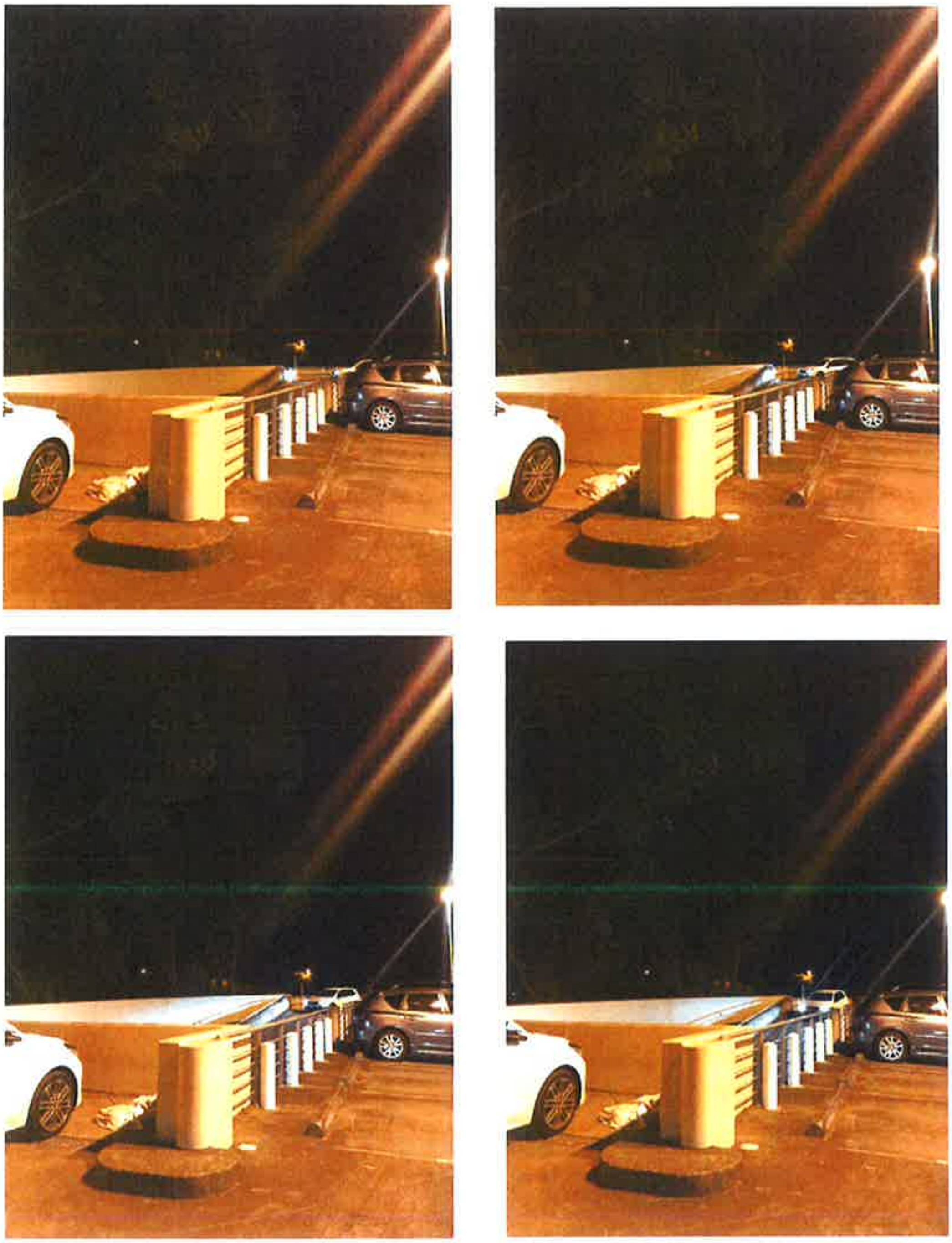
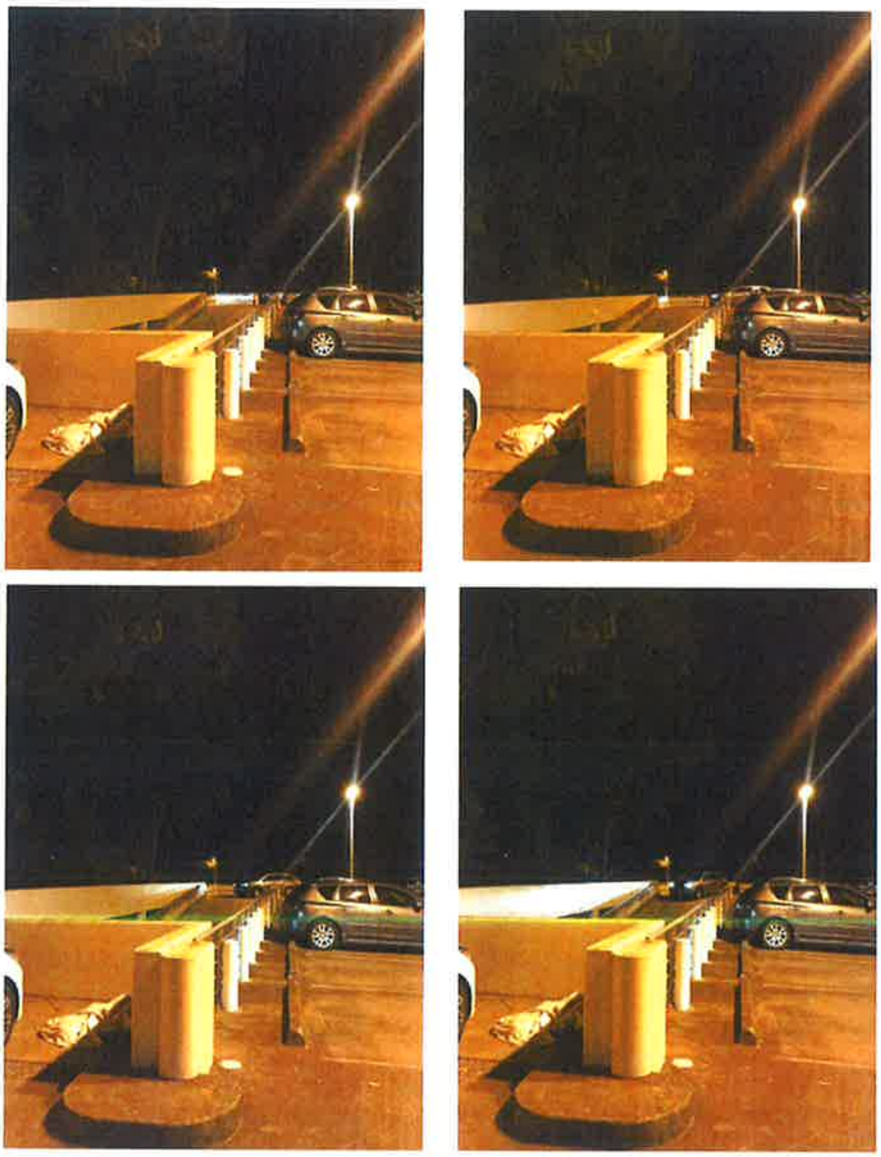
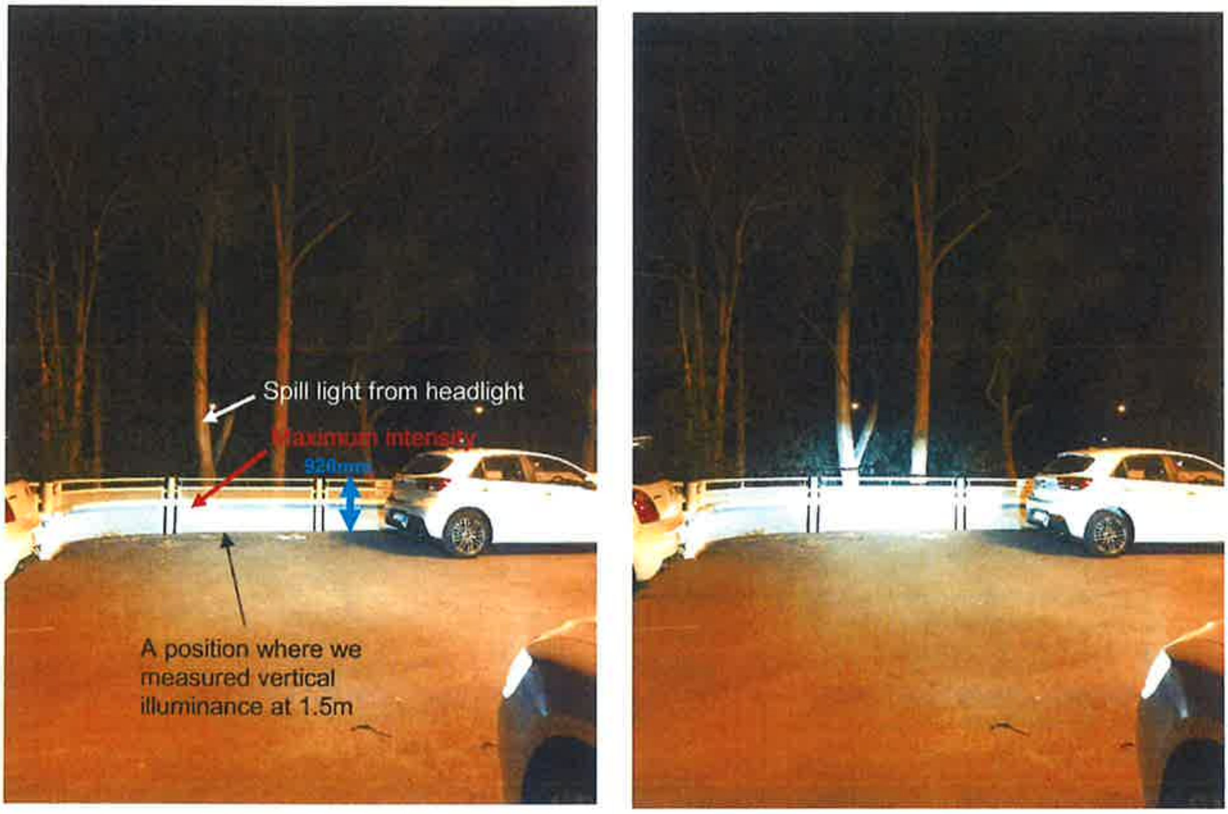


Photo 4-5: SUV approached the exit ramp



4.4.4 The photos of low-beam and high-beam from headlights on the boundary balustrade and trees showing the height of spill light. (See **Photo 4-6**)

Photo 4-6: Low beam and high beam on boundary



Low Beam High Beam

4.4.5 To find out the value of vertical illuminance from the headlight, we have measured vertical illuminance without headlight at the centre of the light beam on the boundary at 1500mm and then at the same location, we measured vertical illuminance values with headlights where the car is located at each light pole. The vertical illuminance value without headlight is 30lx and the maximum vertical illuminance with headlight is 36lx. We can assume that the spill light from headlight (low-beam) is 6lx at the boundary at 1500mm AFFL which is lower than maximum allowance value during pre-curfew hours of 10lux. (See **Appendix D**)

5 . AGi32 Lighting Calculation

5.1 LIGHTING CALCULATION REPORT

5.1.1 A report on obtrusive light compliance in accordance with AS4282-1997 is automatically generated with AGi32 software. (See

Appendix E for a report of Pre-Curfew hours and **Appendix F** for a report of Curfew hours)

Obtrusive Light - Compliance Report

AS 4282-1997, Pre-Curfew, Commercial
Filename: obtrusive light calc
7/06/2018 9:23:52 AM

Illuminance

Maximum Allowable Value: 25 Lux

Calculations Tested (8):

Calculation Label	Test Results	Max Illum
ObtrusiveLight_Bld Perimeter_Ill_Seg1	PASS	13.0
ObtrusiveLight_Bld Perimeter_Ill_Seg2	PASS	3.0
ObtrusiveLight_Bld Perimeter_Ill_Seg3	PASS	1.4
ObtrusiveLight_Bld Perimeter_Ill_Seg4	PASS	0.8
ObtrusiveLight_Bld Perimeter_Ill_Seg5	PASS	3.7
ObtrusiveLight_Bld Perimeter_Ill_Seg6	PASS	2.7
ObtrusiveLight_Bld Perimeter_Ill_Seg7	PASS	7.6
ObtrusiveLight_Bld Perimeter_Ill_Seg8	PASS	0.9

Luminous Intensity (Cd) Per Luminaire

Maximum Allowable Value: 7500 Cd
Control Angle: 83 Degrees

Luminaire Locations Tested (8)
Test Results: **PASS**

Obtrusive Light - Compliance Report

AS 4282-1997, Post-Curfew, Commercial
Filename: post curfew obtrusive light calc
7/06/2018 2:31:32 PM

Illuminance

Maximum Allowable Value: 4 Lux

Calculations Tested (8):

Calculation Label	Test Results	Max Illum
ObtrusiveLight_Bld Perimeter_Ill_Seg1	FAIL	13.0
ObtrusiveLight_Bld Perimeter_Ill_Seg2	PASS	3.0
ObtrusiveLight_Bld Perimeter_Ill_Seg3	PASS	1.4
ObtrusiveLight_Bld Perimeter_Ill_Seg4	PASS	0.8
ObtrusiveLight_Bld Perimeter_Ill_Seg5	PASS	3.7
ObtrusiveLight_Bld Perimeter_Ill_Seg6	PASS	2.7
ObtrusiveLight_Bld Perimeter_Ill_Seg7	FAIL	7.6
ObtrusiveLight_Bld Perimeter_Ill_Seg8	PASS	0.9

Luminous Intensity (Cd) At Vertical Planes

Maximum Allowable Value: 2500 Cd

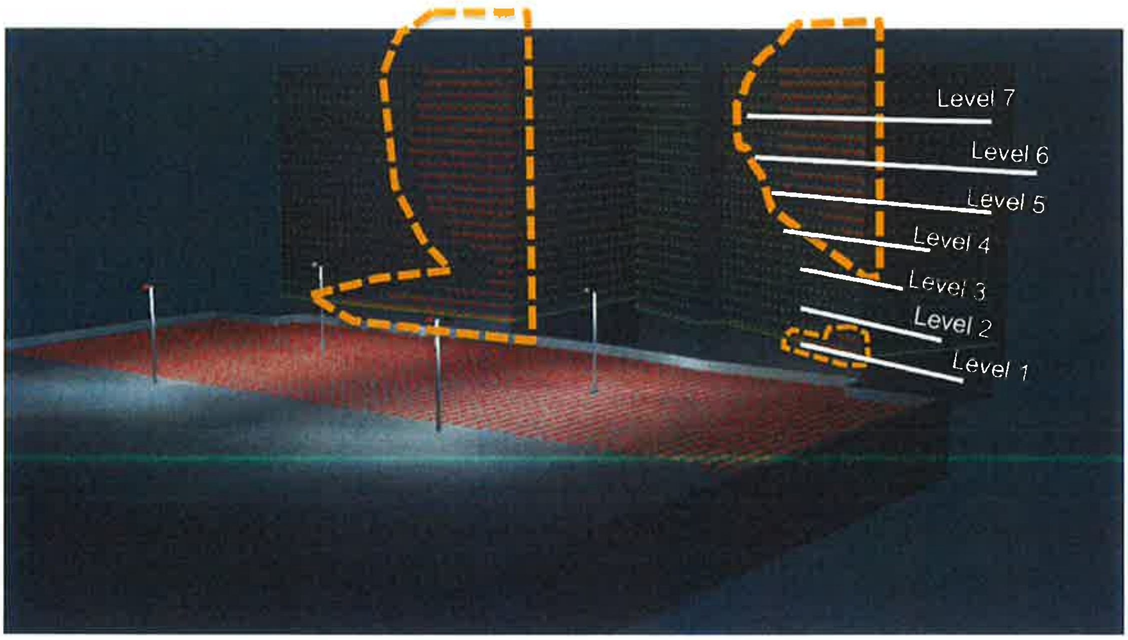
Calculations Tested (8):

Calculation Label	Test Results
ObtrusiveLight_Bld Perimeter_Cd_Seg1	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg2	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg3	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg4	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg5	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg6	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg7	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg8	PASS

5.2 Lighting Report Conclusion

5.2.1 From the above results, the vertical spill light illumination during pre-curfew is below the permitted maximum of 25 lux.
However, there are some areas on the new development boundaries that the vertical spill light values is over 4 lux allowance. The maximum calculated vertical spill light illumination on the property boundaries is 13 lux, at the façade of the new development without the shielding effect of any trees. (See **Figure 5-1**) Further detail is provided in **Appendix F**.

Figure 5-1: Areas where Spill Light is over the permitted maximum of 4 lux during the Curfewed Hours



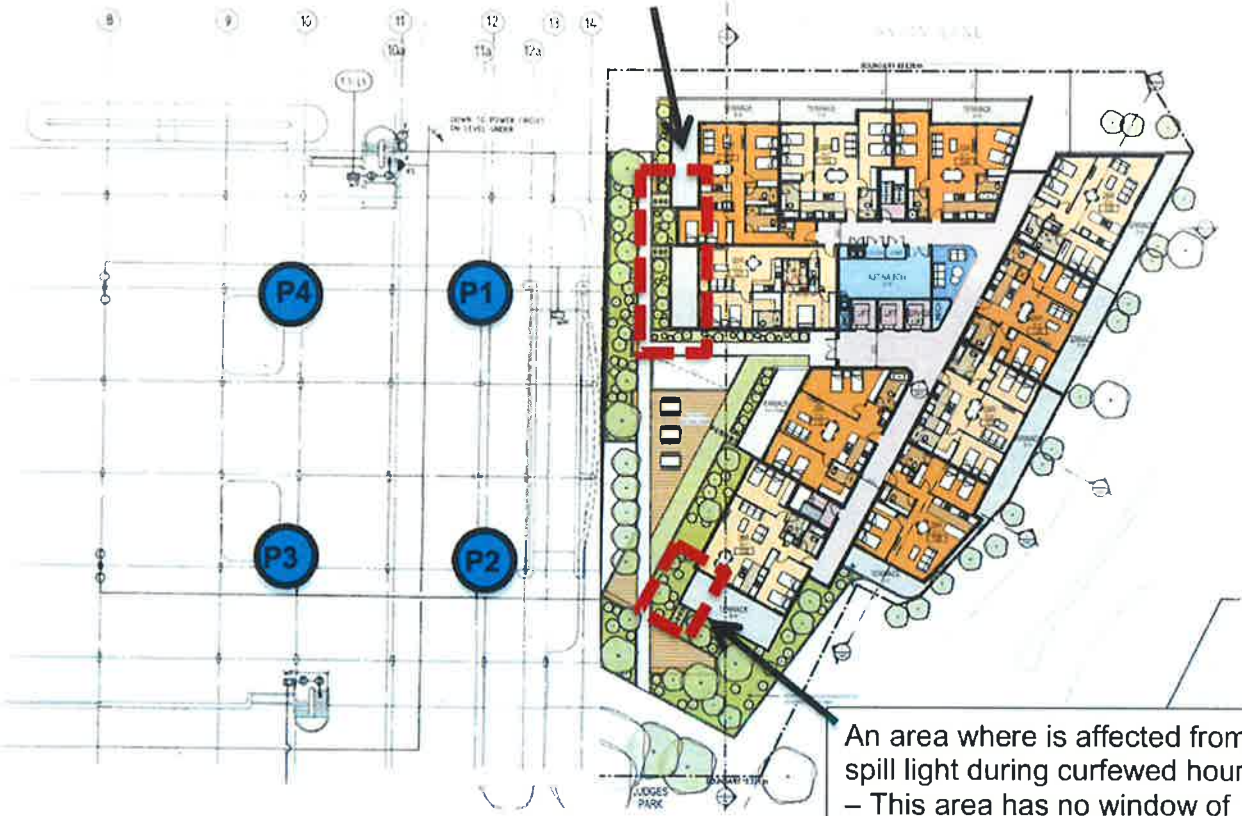
6 . Review of DA drawings

6.1 Review of Affected Areas from Spill Light during Curfew

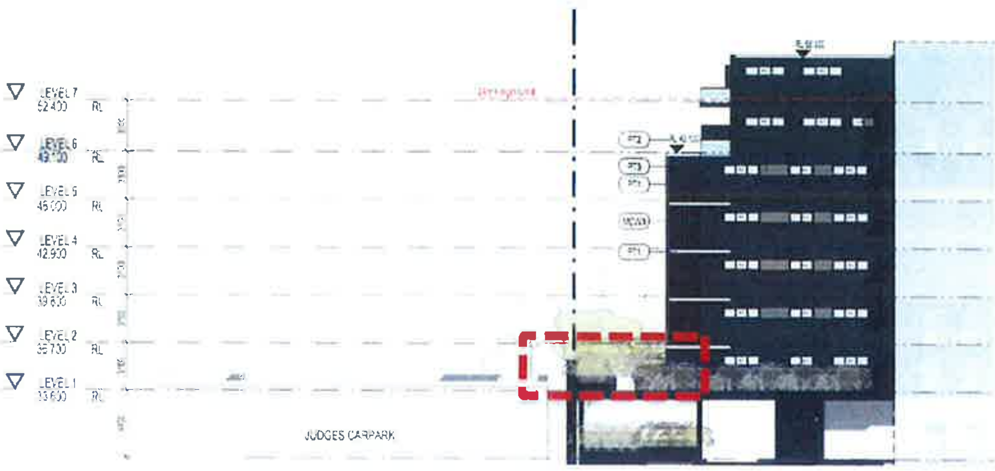
6.1.1 The adverse lighting effects has been evaluated on each floor according to the results from AGi32 for post-curfew. (See **Figure 6-1 to 6-4**)

Figure 6-1: Podium Level or Level 1

An area where is affected from spill light during curfewed hours – This area has a window / balcony door of the bedroom. However, this level has trees and screen along the boundary as a light trespass shield.



An area where is affected from spill light during curfewed hours – This area has no window of the bedroom



DESIGN B

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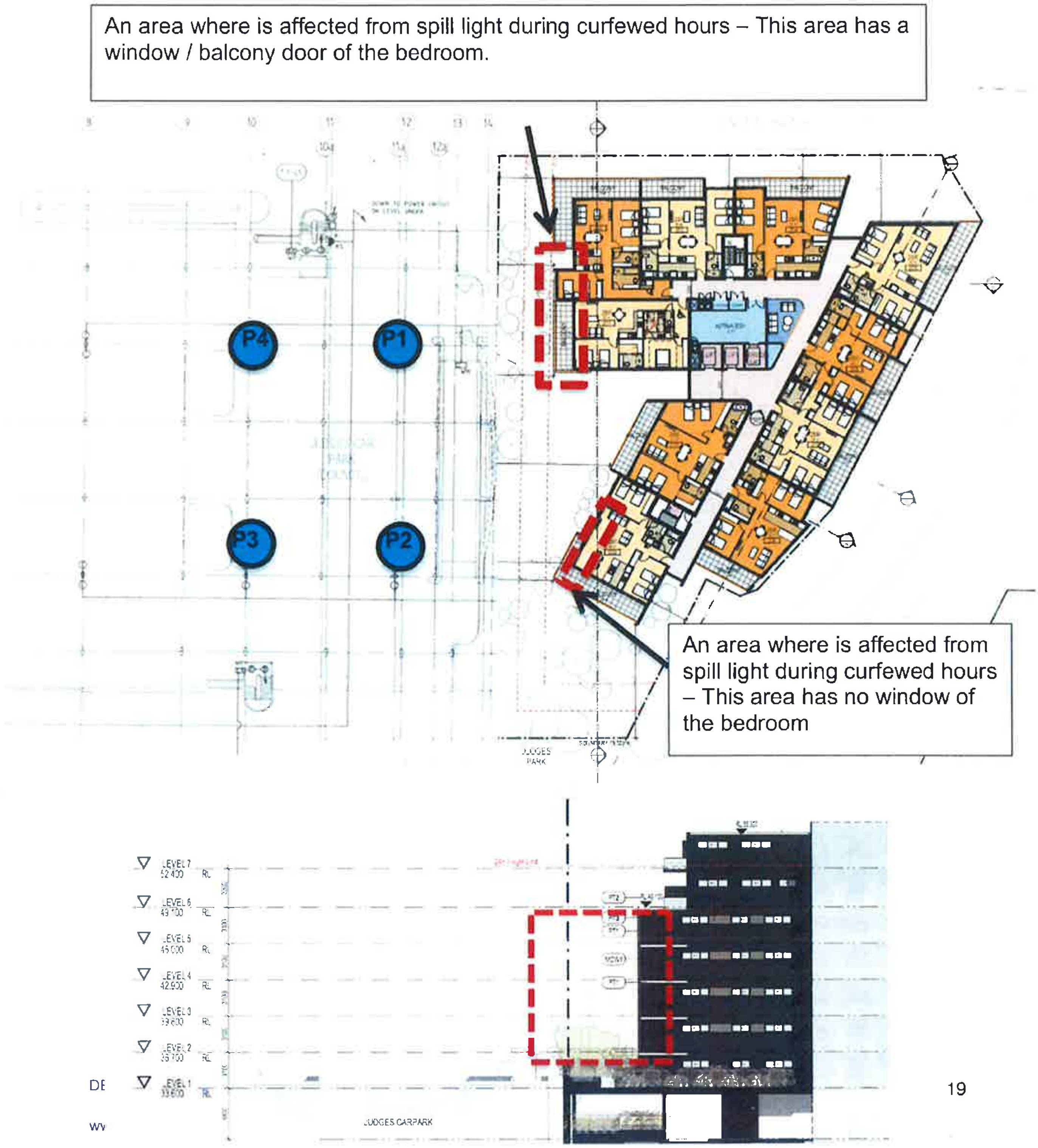
18

ELEVATION - SOUTH 2

Figure 6-2: Level 2 - 5



ELEVATION - SOUTH 2

Figure 6-3: Level 6

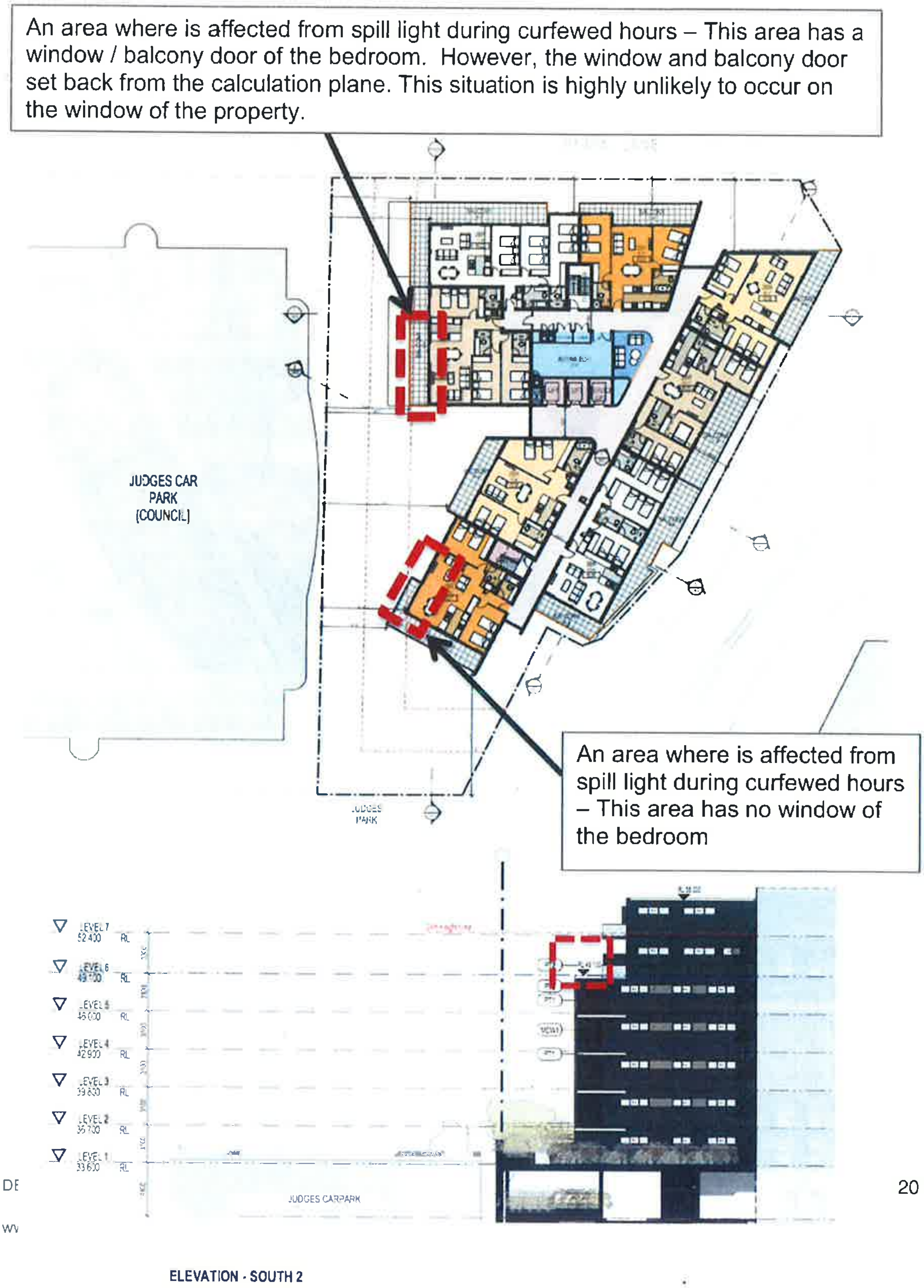
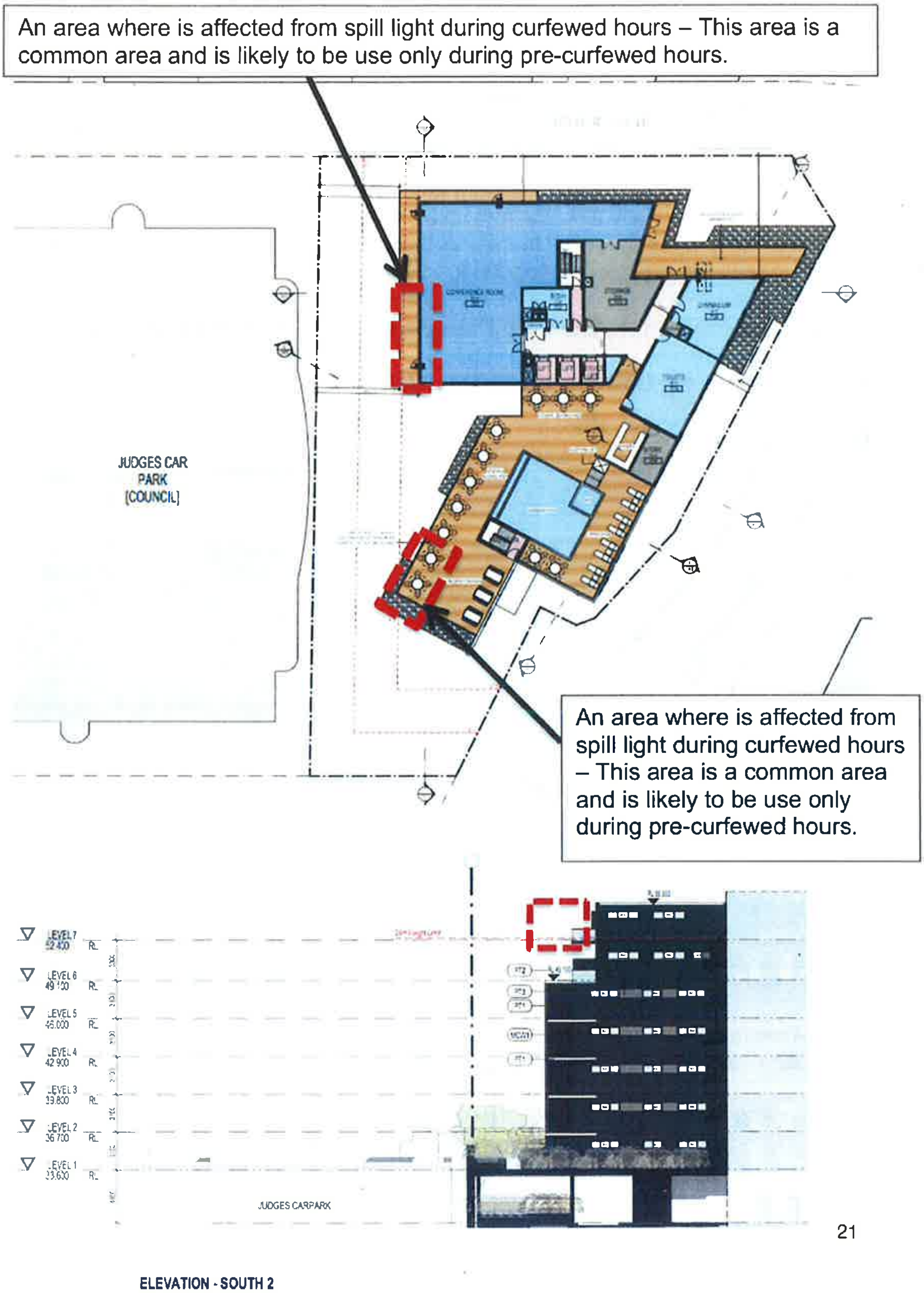


Figure 6-4: Level 7

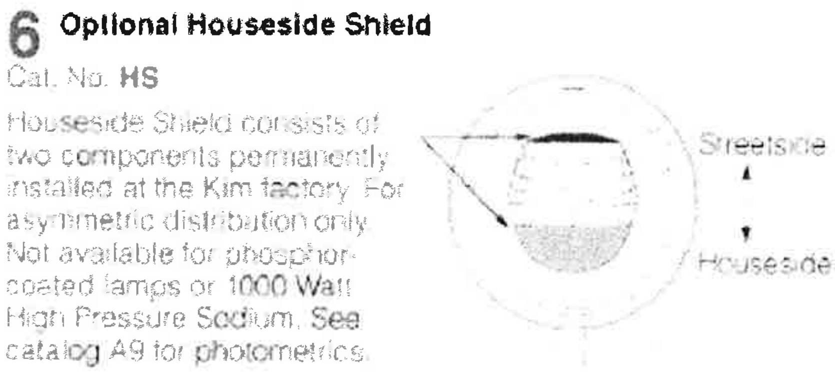


7 . Lighting Strategy

7.1 Propose Use of Glare Shield

7.1.1 KIM Lighting have glare shields which are standard shields that normally are placed house side, or they can engineer custom shields as required for the site to better manage obtrusive light without having to replace existing fitting. (See **Figure 7-1**)

Figure 7-1: Standard Houseside Shield from KIM Lighting



7.1.2 Propose glare shield to block the upward light of the wall mounted batten above the exit ramp.

7.2 Propose operating time for lights along the property boundary of adjacent new development

7.2.1 Judges Car Park operates from 6 am to 10pm and after 10pm it is understandable that there shall be some lights operating for safety purposes. We highly recommend post top lights which are close to the property boundary on the Eastern side to be turned off after 11pm which is the start of curfew time. This will provide an 1 hour window time for people to drive out safely after 10pm.

7.3 Suggest the new screen and mature trees in the New Development

7.3.1 The height of the new screen shall be 2m height and new trees shall be mature and have high density of canopy to shield the light trespass and headlight intrusion.

8 . APPENDIX A

Australian Standard®

Control of the obtrusive effects of outdoor lighting

(ii) harbours, airports, waterways, roads or railway systems where spill light from the proposed development may interfere with the visibility of signalling systems; or

(iii) community and scientific optical observatories where spill light from the proposed development may interfere with astronomical observations.

2.6 SPECIFIC EFFECTS AND RELEVANT LIGHT TECHNICAL PARAMETERS

2.6.1 Effects on residents Effects on residents generally involve a perceived change in amenity arising from either of the following:

(a) The illumination from spill light being obtrusive, particularly where the light enters rooms of dwellings that are normally dark, e.g. bedrooms. The illuminance on surfaces, particularly vertical surfaces, is an indicator of this effect.

(b) The direct view of bright luminaires from normal viewing directions causing annoyance, distraction or even discomfort. The luminance of a luminaire, in a nominated direction, is an indicator of this effect. However, because luminance data is not normally provided by luminaire manufacturers and because of difficulties associated with the measurement of luminance, recommendations in this Standard are expressed in terms of the luminous intensity in specified directions.

The tolerable levels of each of these light technical parameters will be influenced by the ambient lighting existing in that environment. This will be determined largely by the degree and type of the development of the area and by the road lighting in place.

Values of the light technical parameters that are acceptable during the earlier hours of the evening may become intolerable if they persist at later times when residents wish to sleep.

2.6.2 Effects on transport system users Effects on road users (e.g. motorists, cyclists, pedestrians) normally involve a reduction in the ability to see caused by disability glare from bright light sources. The contrast of other objects and the surrounds to the user will be lowered, rendering them less visible or even invisible, especially if the environment is intrinsically dark. The magnitude of the effect will depend on the level of lighting to which the user is adapted. The relevant indicator is the threshold increment which is also used to specify the limitation of glare in road lighting (see AS/NZS 1158.1.1).

Where transport systems operate in the proximity of a proposed outdoor lighting installation, the relevant transport authority (i.e. road, marine, waterway, rail or air) should be consulted. Statutory requirements may apply; for example, regulations issued by the Civil Aviation Authority apply to the effect of outdoor lighting on air navigation.*

2.6.3 Effects on transport signalling systems Effects on transport signalling systems will normally involve a reduction in the visibility of the signals either by—

(a) disability glare, as described in Clause 2.6.2; or

(b) visual clutter, where signals are viewed against a competing background of other lights; the effect is exacerbated if these lights are coloured.

Where signals are in the proximity of a proposed outdoor lighting installation, the relevant road, marine, waterway, rail or air transport authority should be consulted. Statutory requirements sometimes apply; for example, regulations issued by the Civil Aviation Authority apply to the effect of outdoor lighting on air navigation.*

* See References 3 and 4 in Appendix B.

TABLE 2.1

RECOMMENDED MAXIMUM VALUES OF LIGHT TECHNICAL PARAMETERS FOR THE CONTROL OF OBTRUSIVE LIGHT
(See Clause 2.7)

1	2	3	4	5
Light technical parameter	**Application or calculation conditions (see also Figure 2.1 and Section 5)**	**Recommended maximum values**		
		In commercial areas or at boundary of commercial and residential areas*	**Residential areas**	
			Light surrounds†	**Dark surrounds‡**
Illuminance in vertical plane (E_v)	*Pre-curfew:* Limits apply at relevant boundaries of nearby residential properties, in a vertical plane parallel to the relevant boundary, to a height commensurate with the height of the potentially affected dwellings. Values given are for the direct component of illuminance	25 lx	10 lx	10 lx
	Curfewed hours: Limits apply in the plane of the windows of habitable rooms of dwellings on nearby residential properties. In the absence of development (i.e. vacant allotment), the limits apply on the potentially affected property, in a vertical plane parallel to the relevant boundary, at the minimum setback permitted for a dwelling, to a height commensurate with land use zoning provisions. Values given are for the direct component of illuminance	4 lx	2 lx	1 lx
Luminous intensity emitted by luminaires (I)	*Pre-curfew:* Limits apply to each luminaire (irrespective of the number on a head frame) in the principal plane, for all angles at and above the control direction, when aimed in accordance with the installation design	Limits as determined from Table 2.2. Alternatively, the limits and method of assessment associated with curfewed hours may be applied, at the discretion of the designer (see Clauses 2.7.1 and 2.7.2)		
	Curfewed hours: Limits apply in directions where views of bright surfaces of luminaires are likely to be troublesome to residents, from positions where such views are likely to be maintained, i.e. not where momentary or short-term viewing is involved	2 500 cd	1 000 cd	500 cd
Threshold increment (TI)	Limits apply at all times where users of transport systems are subject to a reduction in the ability to see essential information. Values given are for relevant positions and viewing directions in the path of travel	20% based on adaptation luminance ($\bar{L}$) of 10 cd/m^2	20% based on adaptation luminance ($\bar{L}$) of 1 cd/m^2	20% based on adaptation luminance ($\bar{L}$) of 0.1 cd/m^2

* Applies to residential accommodation in commercial areas or at the boundary between commercial and residential areas. The term 'commercial' is used as a generic description for zoning which provides for urban uses other than residential.

† Where the affected property abuts roads that are lit to Category V5 or higher in accordance with AS/NZS 1158.1.1.

‡ Where the affected property abuts roads that are lit to Category B1 or lower in accordance with AS 1158.1, or where there is no lighting.

TABLE 2.2

MAXIMUM LUMINOUS INTENSITY PER LUMINAIRE FOR PRE-CURFEW OPERATING TIMES

(See Table 2.1)

1	2	3	4
Area description		**Maximum luminous intensity from each luminaire***	
Size of area	**Controlling dimension (Figure 5.1)**	**Level 1 control (Note 1)**	**Level 2 control (Note 2)**
Large	>75 m	7 500 cd	100 000 cd
Medium	≥25 m ≤75 m	7 500 cd	50 000 cd
Small	<25 m	2 500 cd	25 000 cd

* Limits apply to each luminaire (irrespective of the number on a head frame) in the principle plane, for all angles at and above the control direction, when aimed in accordance with the installation design (see Clause 5.3.2.1).

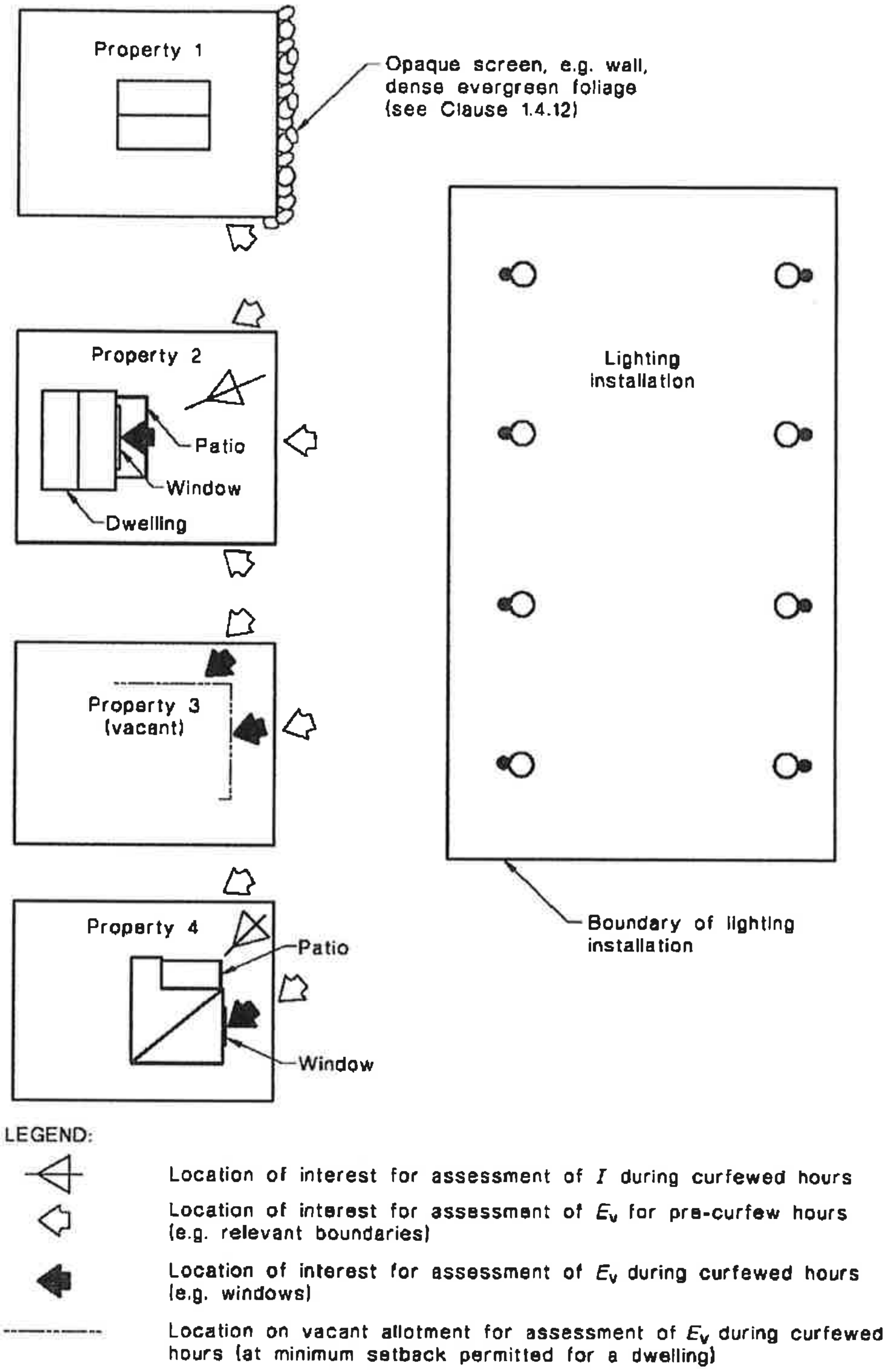
NOTES:

1 Level 1 control is appropriate for development control of environmentally sensitive areas, i.e. where the existing environment is of high quality, where abutting properties are close to the installation, where they are residential in nature, where the existing ambient light levels are low and where the community requires the best available environmental safeguards to be applied.

As the use of Type C cut-off luminaires† is likely to be necessary for Level 1 control, the implementation of this level of control will normally be possible only for lighting applications that require relatively high illuminances over areas that are small to medium in size, e.g. lighting for tennis courts or hockey fields. However, Level 1 control may also be suitable for larger areas where lower illuminances are appropriate, e.g. for car parks and outdoor storage areas.

2 Level 2 control will permit the use of a wide range of currently used lighting techniques but will limit intensities in the control direction to what might reasonably be expected by careful attention to design and the selection and aiming of luminaires, especially for applications involving Type A luminaires†.

† See Appendix D for details of these luminaire classifications.



NOTE: The pre-curfew assessment of I is based on representative conditions (see Clause 5.3.2.1 and Paragraph C3.3, Appendix C). The assessment of E_v and I for curfewed hours requires details of dwellings (see Property 2 and Property 4).

FIGURE 2.1 EXAMPLE SHOWING APPLICATION OF LIMITS FOR E_v AND I

SECTION 5 CALCULATION OF LIGHT TECHNICAL PARAMETERS

5.1 SCOPE OF SECTION This Section sets out recommended procedures for the calculation of light technical parameters associated with outdoor lighting which are necessary for determining compliance with the limiting values recommended in Tables 2.1 and 2.2.

5.2 DETERMINATION OF ILLUMINANCE

5.2.1 General The limiting values of illuminance recommended in Table 2.1 apply in specified vertical planes, dependent on the times of operation of the lighting system. The values apply to the direct component of illuminance only.

NOTE: In the design of outdoor lighting, consideration should also be given to the possible illuminance contribution from reflected light (see Clause 2.7.2 and Paragraph C3.2, Appendix C).

The illuminance calculations should be made in accordance with Clause 5.2.2. Calculations need not be made for those locations where the direct light is obstructed, e.g. by a high opaque fence, retaining wall, evergreen trees with dense foliage, or buildings of appropriate height.

5.2.2 Illuminance calculations

5.2.2.1 *Use of computer programs* Computer programs used for the calculation of illuminance should be based on the inverse square law method. Programs using algorithms based on zonal flux are not acceptable. The program should be compatible with the system of photometry used to derive the luminaire photometric data.

The luminous intensity data used as input for the program should cover all of the light emitted by the luminaire(s), not just the angles which define the useful beam.

The luminous intensity data should be obtained from tests conducted by a laboratory that is independently accredited by NATA as having competence to carry out the type of measurements involved, or by a laboratory of another country that is accredited under a mutual recognition agreement with NATA.

The record of the illuminance calculations should state the computer program that was used, including the specific version of that program.

Verification of computer calculations may be carried out by spot checks of various parameters with hand calculations, or with simplified installations and photometric data that allows cross-checking with other computer programs. The data for the calculations given in the Examples in this Section may be used for this purpose. Such spot checks will not verify a computer program for all permutations of geometry, photometric data and other parameters, as the nature of computer programs is such that certain sections of the program may fail to calculate correctly only when a particular combination of data exists.

5.2.2.2 *Calculation conditions for pre-curfew hours* The illuminance calculations should be made for a grid of points in the relevant vertical plane, spaced at intervals of not more than 5 m in azimuth and 1 m in elevation. The vertical extent of the calculation grid will be determined by the height of the highest relevant point on the adjacent properties, e.g. the height of the highest window. The required height of the grid can be determined by the intersection, on a vertical plane at the boundary of the installation, of 'lines of sight' between the luminaires and relevant points on the adjacent properties. Note that height differences resulting from the topography of the area need to be taken into account.

The calculation record should clearly identify, by reference to appropriate plans, the grid points for which calculations were made and the relevant values obtained.

5.2.2.3 *Calculation conditions for curfewed hours* Calculations of vertical illuminance should be made normal to the geometric centre of each applicable window. For large windows, i.e. major dimension 2.5 m or more, the calculations should be made for a grid of points spaced at intervals of not more than 1 m in the plane of the window.

The calculation record should clearly identify, by reference to appropriate plans, the locations of the applicable windows for which the calculations were made and the relevant values obtained.

Calculations necessary to determine the values of vertical illuminance that apply should be made in a similar manner to Example 5.1.

Example 5.1:

For the purpose of this Example, the same data is assumed as given in Example 5.3 for calculations of luminous intensity (see also Figure 5.3).

Photometric coordinates of the luminaire with respect to the point of interest (point P in Figure 5.3):

$B = 0°$

$\beta = 0°$

By interpolation of Table 5.1, the luminous intensity in the direction of the point of interest is shown to be—

= 50 880 cd

Horizontal distance from the luminaire to the point of interest (distance LP in Figure 5.3) is—

$$LP = \sqrt{[(H-P)^2 + NM^2]} \quad \ldots 5.1$$

$$= \sqrt{[(18-3)^2 + 224.11^2]}$$

$$= 224.6 \text{ m}$$

Angle of incidence (A) at point of interest:

$$A = 90° - \sin^{-1}\left[\frac{140}{224.6}\right] \quad \ldots 5.2$$

$$= 51.4°$$

NOTE: The above trigonometry is valid for the geometry of the example. Other place orientations and luminaire geometries are likely to require different trigonometric procedures to determine the angle of incidence.

Vertical illuminance (E_v) at point of interest:

$$E_v = \frac{I \cdot \cos A}{LP^2} \quad \ldots 5.3$$

$$= \frac{50\ 880 \cdot \cos 51.4°}{224.6^2}$$

$$= 0.63 \text{ lx}$$

5.3 DETERMINATION OF LUMINOUS INTENSITIES

5.3.1 General Tables 2.1 and 2.2 set out the recommended maximum luminous intensities in relevant directions. These directions will differ according to the times of operation of the lighting system, as follows:

(a) *Pre-curfew* — the limiting values of luminous intensity apply for each luminaire, in the principal plane, for all angles at and above control direction.

NOTE: The principle plane will usually contain or be very close to the maximum intensity of the light distribution. Controlling intensities in this plane, using the pre-curfew control direction method, will generally provide adequate control of luminous intensities for pre-curfew applications. However, for some photometric distributions and for particular luminaire positioning, aiming requirements and site considerations, this method may not be appropriate due to the limitations that may be imposed on good lighting design, or failure to meet the intent of this Standard. The lighting designer, therefore, has the choice of using the assessment methods and limits applicable to curfewed hours, if this is deemed to be more appropriate (see Clauses 2.7.1 and 2.7.2(a)).

(b) *Curfewed hours* — the limiting values of luminous intensity apply for each luminaire in directions where views of bright surfaces of the luminaire are likely to be troublesome to residents (see Table 2.1).

The values of luminous intensity that apply for a given situation should be determined in accordance with Clause 5.3.2 and checked for compliance with the relevant limit in Table 2.1 or Table 2.2, as applicable. If compliance can be demonstrated with the intensity limits specified for curfewed hours, no assessment of compliance with pre-curfew limits need be conducted, even if the lighting system is to operate only during pre-curfew hours.

NOTE: The assessment method and associated limits for curfewed hours are more rigorous than those specified for pre-curfew hours. Compliance with pre-curfew limits can therefore be deemed to have been achieved if the lighting system is demonstrated to comply with the limits specified for curfewed hours. (See also Clauses 2.7.1 and 2.7.2(a).)

The luminous intensities should be determined directly from photometric data for the luminaires used, specifically from luminous intensity distribution data. No determination of luminous intensities need be made, for either pre-curfew or curfewed hours, where the luminaires cannot be seen from directions of concern* due to permanent physical obstructions such as a high opaque fence, retaining wall or evergreen trees with dense foliage.

The luminous intensity distribution data used should be that applicable to the specific luminaire/lamp combination under evaluation. It will normally provide, in tabular or electronic form, values of luminous intensity at various angular increments with respect to a reference direction. It is important to note in which angular format the intensity data are given, i.e. B, β or C, γ (see Ref. 18, Appendix B).

The luminous intensity data should be obtained from tests conducted by a laboratory that is independently accredited by NATA† as having competence to carry out the type of measurements involved, or by a laboratory of another country that is accredited under a mutual recognition agreement with NATA.

For the particular luminaire, it will be necessary to establish the geometric relationship of the relevant direction with the angles for which the luminous intensity data is given. Some interpolation of the data may be necessary but care should be taken where the intensity distribution undergoes rapid change.

* See Column 2 of Table 2.1.

† National Association of Testing Authorities

The values of luminous intensity derived from the data will normally be expressed in terms of candelas per 1000 lamp lumens and the value should therefore be multiplied by the total luminous flux (rated initial values) of the lamp(s) in kilolumens.

Where two or more luminaires are installed at the one location, e.g. on the headframe of a specific pole or tower, the luminous intensity in the relevant direction should be separately determined by the above procedure for each of the luminaires involved.

5.3.2 Luminous intensity calculations

5.3.2.1 *Pre-curfew* To assess compliance with the luminous intensity limits for pre-curfew times, as given in Table 2.2, the control direction should first be established, as shown in Figure 5.1. The control direction is a representative direction* and lies in the principal vertical plane of the luminaire light distribution, which is the plane that commonly contains the maximum luminous intensity (or the centre of the beam if there is no unique maximum), or luminous intensities that are close to the maximum.

The luminous intensity in the control direction should be determined as follows:

(a) *Intensity data in B, β angular format* The intensity value should be read from the luminaire intensity distribution data at an angle p above the reference direction which is defined in Clause 1.4.11 and illustrated in Figure 5.1.

The value of the angle p should be determined from the following equation, by reference to Figure 5.1:

$$p = 90 - (a + r) \qquad \ldots 5.4$$

where

a = the reference angle (see Notes to Figure 5.1)

r = the angular displacement of the control direction below the horizontal, taken as —

(i) 10° for a controlling dimension less than 25 m; and

(ii) 7° for a controlling dimension equal to or greater than 25 m.

The controlling dimension (given in Table 2.2, Column 2) is the sum of the dimensions D and S in Figure 5.1.

Where the reference axis of the light distribution and the direction of maximum luminous intensity do not coincide (e.g. when the maximum intensity is not emitted perpendicular to the cover glass of the floodlight), the light distribution data should be adjusted so that the two directions are in coincidence before reading off the luminous intensity for the angle p, calculated in accordance with Equation 5.4.

Where the maximum luminous intensity does not lie in the principal plane (e.g. when two distinct peaks of intensity exist, displaced in azimuth either side of the principal plane), the luminous intensity in the control direction should be taken as that which would apply if the control direction were rotated in azimuth to lie in the vertical plane containing the direction of maximum intensity.

Where the same floodlight is used throughout the installation, the determination of the luminous intensity in the control direction need only be made for the luminaire with the highest aiming angle (see Figure 5.1).

* See Paragraph C3.3, Appendix C.

(b) *Intensity data in C, γ angular format* Where the intensity distribution is in the C, γ angular format, e.g. road lighting luminaires, the reference direction normally corresponds to the downward vertical axis through the luminaire. For side-entry luminaires this will apply if the mounting spigot is horizontal. In these circumstances the angle p should be determined from the following equation:

$$p = 90 - r \qquad \ldots 5.5$$

$= 80°$ where the controlling dimension is less than 25 m

$= 83°$ where the controlling dimension is equal to or greater than 25 m

Where the mounting spigot is tilted above the horizontal by the angle S, then the angle p should be determined from the following equation:

$$p = 90 - (S + r) \qquad \ldots 5.6$$

In practice, the angle S should be relatively small, if not zero.

The luminous intensity in the control direction, determined in accordance with the procedure outlined in Item (a) or (b), as appropriate, should be checked for compliance with the relevant limit in Table 2.2. A check should also be made that luminous intensities above the control direction, in the principal plane, do not exceed the applicable limit in Table 2.2.

Example 5.2:

For the purpose of this example assume the following data:

(a) *Luminaire* —Type B floodlight*; 2000 W metal halide lamp; output 240 000 lm; luminous intensity distribution data in B, β angular format in accordance with Table 5.1.

(b) *Application (see Figure 5.1)* —D = 55 m; S = 3 m; a = 66°.

To determine the luminous intensity in the control direction, as follows, derive the angle p in Figure 5.1 by use of Equation 5.4, viz.

$$p = 90° - (66° + 7°)$$
$$= 17°$$

Reference to Table 5.1 shows the luminous intensity at p = 17° (i.e. B = 17°) in the principal plane (i.e. β = 0°) to be (by interpolation) 223 cd per 1000 lamp lumens. The luminous intensity in the control direction, in candelas, will therefore be—

223 × 240 = 53 500 cd

Note that the luminous intensity data of Table 5.1 are given in the B, β format of photometric data presentation. If the data are in the C, γ format, a similar procedure applies as set out in Clause 5.3.2.1(b) but care should be taken in calculating the applicable C and γ angles.

From Figure 5.1, the controlling dimension ($D + S$) is—

55 + 3 = 58 m

Comparing the luminous intensity in the control direction with the maximum value permitted in Table 2.2 (size of area: medium, Level 2 control) shows the installation to have marginally failed, i.e. 53 500 cd actual compared with a limiting value of 50 000 cd.

* See information on floodlight classifications in Appendix C.

Adjust the floodlight aim 1° down so a = 65° and thus p = 18°. Reference to Table 5.1 shows the luminous intensity in the control direction is now 49 000 cd. The installation will now therefore satisfy Table 2.2.

Reference to Table 5.1 shows that luminous intensities at angles of greater than the control direction (i.e. 18°) are progressively reducing, compared to the luminous intensity in the control direction, and will therefore be below the 50 000 cd limit.

5.3.2.2 *Curfewed hours* The luminous intensity from the subject luminaire should be determined in directions in which views of the bright surfaces of the luminaire are likely to be troublesome to residents (see Table 2.1 and Figure 2.1).

The luminous intensities should be determined for the actual locations and directions that apply, in a similar manner to Example 5.3.

Example 5.3:

For the purpose of this example assume the following data (see also Figure 5.3):

(a) *Luminaire* — as given in Example 5.2.

(b) *Application* — luminaire mounting height 18 m; aimed 65° above the downward vertical and 30° in azimuth to house side of normal to subject area; a residential area with light surrounds.

(c) *Position of window of potentially affected dwelling* — located as follows:

(i) Distance in front of luminaire (across subject area) — 140 m.

(ii) Distance to side of luminaire (along subject area) — 175 m.

(iii) Height of window — 3 m.

Determine the angles of offset of the window with respect to the luminaire aiming direction, viz.

(A) *in azimuth*:

angle h $= \tan^{-1} \dfrac{175}{140}$

$= 51.34°$ (in horizontal plane)

angle g $= h - 30°$

$= 21.34°$ (in horizontal plane)

distance $NM = QP = \sqrt{(140^2 + 175^2)}$

$= 224.11$ m

distance $PS = MT = QP \sin g$

$= 81.55$ m

distance $QS = QP \cos g$

$= 208.74$ m

distance $LS = \sqrt{(QS^2 + LQ^2)}$

$= 209.28$ m

NOTE: LQ = luminaire height − window height

$= 18 - 3 = 15$ m

angle β $= \tan^{-1} \dfrac{PS}{LS} = \tan^{-1} \dfrac{81.55}{209.28}$

$= 21.29°$

NOTE: Angle β is used to determine the applicable luminous intensity from Table 5.1.

(B) *in elevation:*

angle j $= \tan^{-1} \dfrac{QS}{LQ} = \tan^{-1} \dfrac{208.74}{15}$

$= 85.9°$

angle B $= j - 65°$

$= 20.9°$

Reference to Table 5.1 shows the luminous intensity in the direction of the window (B = 20.9°, β = 21.29°) to be, by interpolation—

212 × 240 = 50 880 cd

This is more than 50 times the maximum intensity recommended in Table 2.1 for operation during curfewed hours. A review of the design would be needed and might involve one or more of the following:

(1) Re-aiming the floodlight further away, horizontally, from the window of the dwelling.

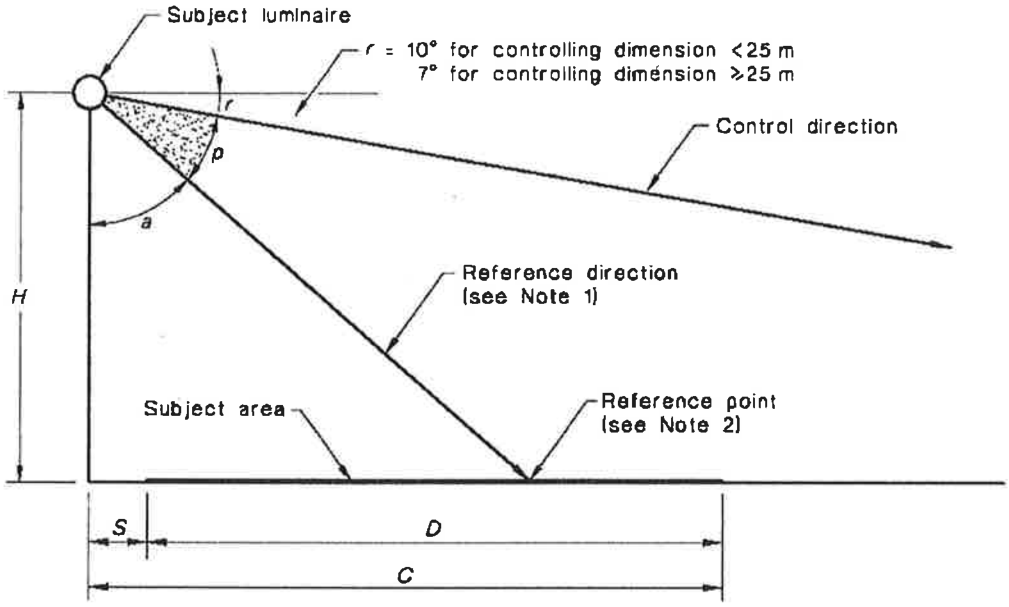
(2) Reducing the aiming angle, perhaps by increasing the luminaire mounting height.

(3) The fitting of baffles, shields or louvres to screen the view of the floodlight from the window of the dwelling.

(3) Relocation of the floodlight, perhaps to the other side of the subject area.

(4) The selection of an alternative type of floodlight.

Calculations similar to the above reveal that, if the floodlight is re-aimed in azimuth in a plane perpendicular to the subject area (i.e. 30° horizontally further from the aiming direction assumed in the example), the intensity in the direction of the window is reduced (to 5300 cd) but still exceeds the maximum value permitted in Table 2.1. This results from the relatively broad light distribution in azimuth of the Type B floodlight and the high lumen output provided by the 2000 W metal halide lamp.



LEGEND:

H = mounting height of the subject luminaire above the plane of the subject area
S = setback of the luminaire from the edge of the subject area, perpendicular to the edge of the subject area (see Figure 5.2)
D = dimension of the subject area, perpendicular to the edge of the subjectarea (see Figure 5.2)
C = controlling dimension, i.e. *D* + *S* (see Table 2.2)
a - reference angle (aiming angle, in elevation, of the subject luminaire (see Note 3))
p = angular displacement, in elevation, of the control direction from the reference direction
r = angular difference between control direction and the horizontal

NOTES:

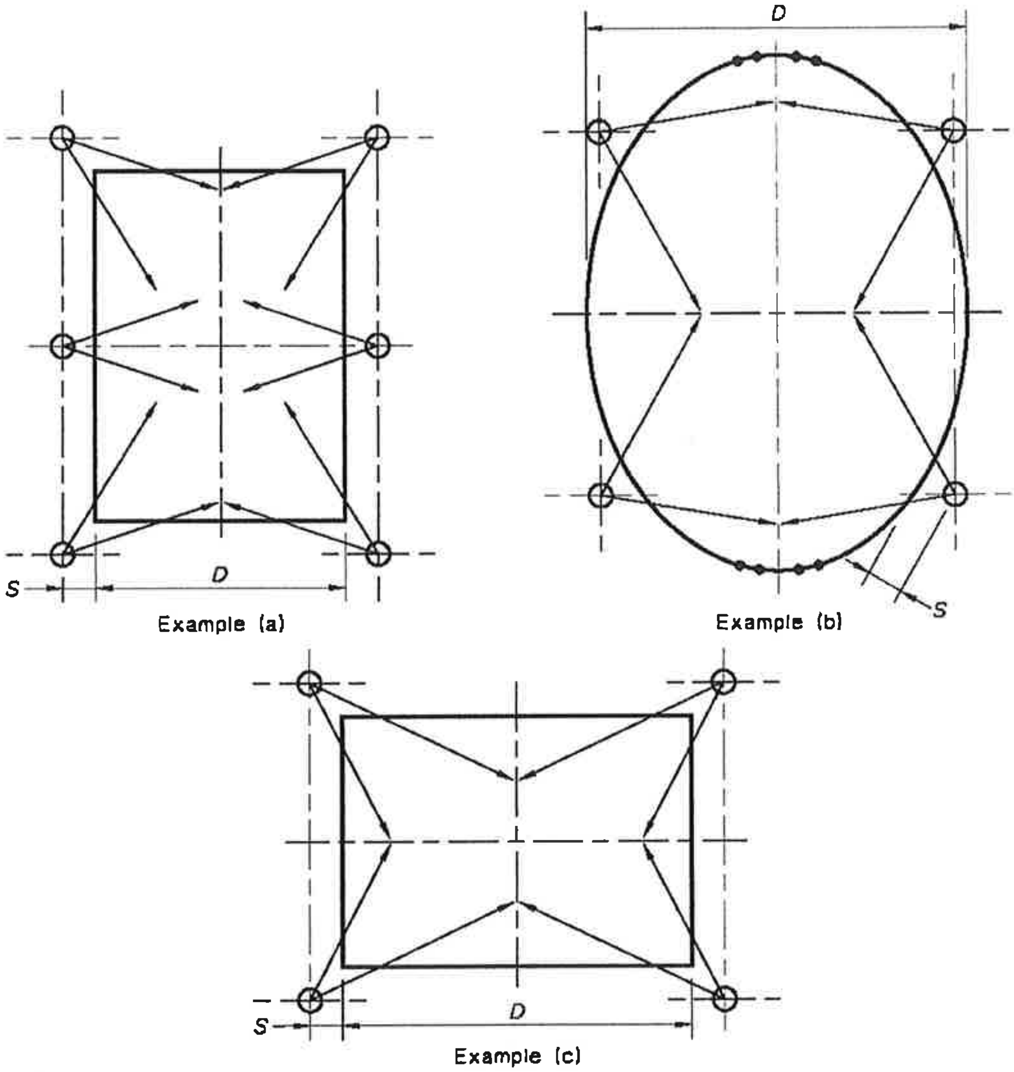
1 The reference direction is the direction of maximum intensity from the floodlight (or the direction of the beam where there is no unique maximum). Most often this is the direction of the origin to which the intensity distribution is referred. The reference and control directions are in the same vertical plane, i.e. the principal plane of the light distribution of the floodlight.

2 The reference point is the point to which the maximum luminous intensity from the floodlight is aimed. Most often this will coincide with the aiming point for the luminaire in the design specification.

3 Angle *a* will most often be the aiming angle of the floodlight (in elevation) in the design specification, i.e. when the reference direction coincides with origin of the direction of the maximum luminous intensity from the floodlight.

4 See Figure 5.2 for examples illustrating, in plan view, application of the principles of Figure 5.1 to specific areas.

FIGURE 5.1 THE SUBJECT LUMINAIRE AND AREA AND THEIR RELATIONSHIP WITH THE CONTROL AND REFERENCE DIRECTIONS



LEGEND:

S = setback of the luminaire from the edge of the subject area, perpendicular to the edge of the subject area

D = dimension of the subject area, perpendicular to the edge of the area, in the direction of the longest light throw

—► = reference direction (see Clause 1.4.11)

(symbol) = multiple floodlights, located and aimed as shown

NOTES:

1 Dimensions *S* and *D* are perpendicular to the edge of the subject area, irrespective of how the luminaire is actually aimed across the area. These dimensions are used to derive representative conditions for the determination of compliance with Table 2.2. If the luminous intensity determined for the representative condition is less than the maximum value recommended in Table 2.2, the luminaire is deemed to comply for the actual conditions of installation.

2 The floodlight locations, aiming points and aiming directions are illustrative only. Two floodlights per pole are shown.

FIGURE 5.2 EXAMPLES ILLUSTRATING, IN PLAN VIEW, APPLICATION OF THE PRINCIPLES OF FIGURE 5.1 TO SPECIFIC AREAS

TABLE 5.1

LUMINOUS INTENSITY DISTRIBUTION DATA FOR FLOODLIGHT USED IN EXAMPLES 5.1, 5.2 AND 5.3

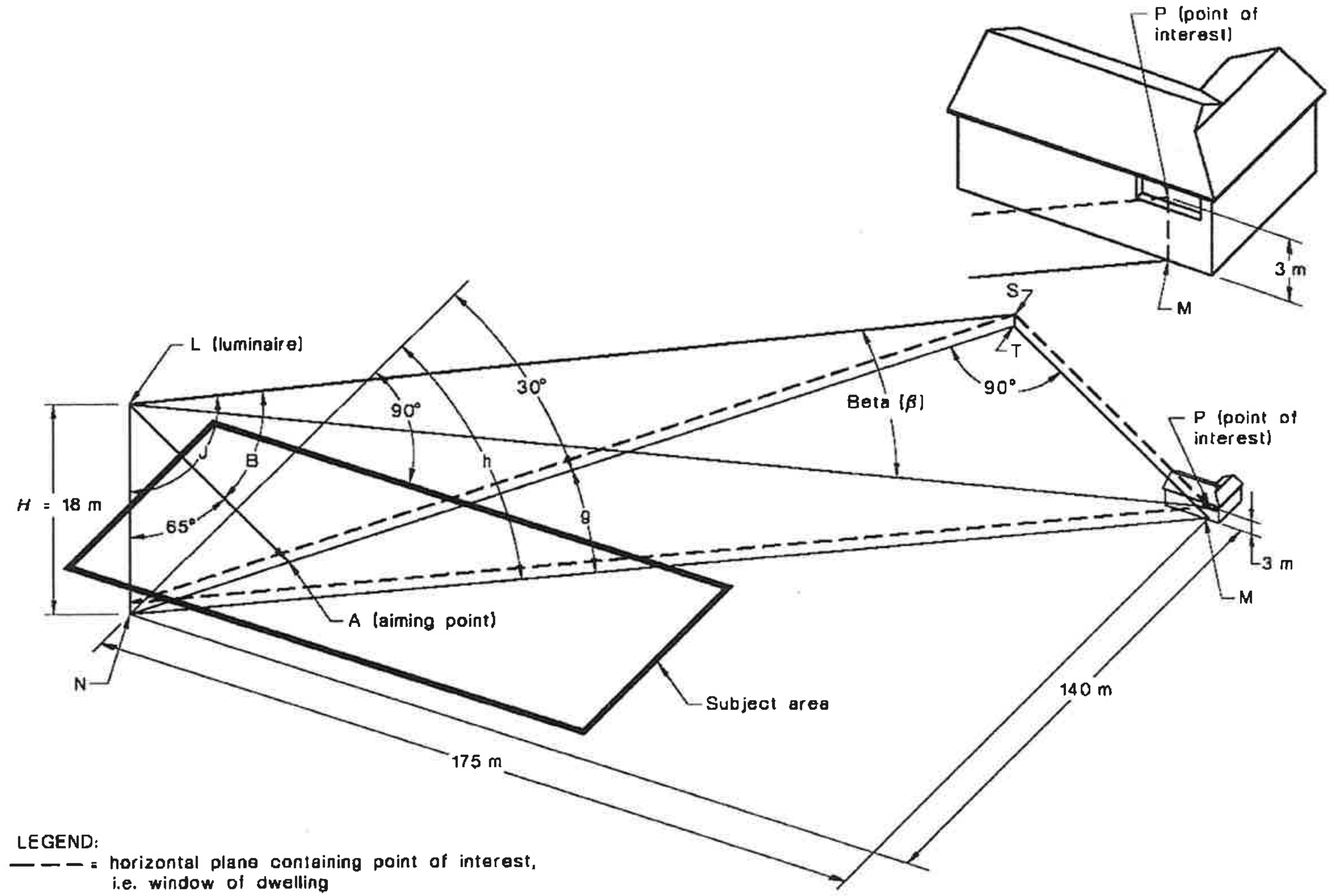
B angle, degrees	Luminous intensity (*I*), cd/1000 lamp lumens																		
	β angle, degrees (left/right)																		
	0	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**
30	129	130	142	159	179	180	158	124	80	42	14	11	9	5	2	1	0	0	0
28	132	134	145	160	181	183	164	134	83	44	14	11	9	5	2	1	0	0	0
26	137	139	149	163	182	188	169	134	85	48	15	11	9	7	2	1	0	0	0
24	145	147	156	169	187	198	182	146	89	57	19	12	11	7	3	1	1	0	0
22	158	159	168	179	198	213	195	154	96	57	19	13	12	8	3	1	0	0	0
20	180	182	191	198	216	231	201	152	101	62	22	16	13	8	3	1	0	0	0
18	204	205	212	220	237	249	218	166	106	68	24	19	14	9	3	1	0	0	0
16	242	242	246	252	269	278	236	178	110	74	30	20	15	8	3	1	1	0	0
14	306	305	307	306	321	325	270	198	115	72	32	22	16	9	3	2	0	0	0
12	418	416	408	399	402	397	325	231	120	75	37	23	17	9	3	2	0	0	0
10	604	597	572	541	533	519	421	282	127	80	40	24	19	10	3	2	1	0	0
8	874	852	798	732	709	686	528	328	137	84	45	26	19	10	3	1	0	0	0
6	1 262	1 225	1 124	1 004	952	911	688	409	152	89	51	27	19	10	3	1	0	0	0
4	1 647	1 586	1 451	1 275	1 192	1 130	870	522	162	93	53	27	17	9	3	1	0	0	0
2	1 836	1 778	1 623	1 441	1 337	1 253	966	555	164	95	54	26	17	9	3	1	0	0	0
0	1 855	1 800	1 662	1 491	1 387	1 293	980	563	163	95	52	26	16	8	3	1	0	0	0
−2	1 399	1 380	1 294	1 194	1 126	1 065	821	474	154	94	49	24	15	8	3	1	0	0	0
−4	775	770	744	707	690	673	538	340	136	82	42	23	15	9	3	1	0	0	0
−6	516	512	497	482	479	472	386	260	122	78	38	21	15	9	3	1	0	0	0
−8	338	335	331	326	330	326	272	189	110	69	34	19	14	9	3	1	0	0	0
−10	266	265	264	265	270	261	219	164	102	63	30	16	12	8	3	1	0	0	0

NOTES:

1 The range of *B* angles has been abbreviated; the data given are confined to that required for Examples 5.1, 5.2 and 5.3. Negative values of *B* refer to angles below the reference axis.

2 The direction of maximum intensity of the light distribution in Table 5.1 coincides with the reference direction, i.e. $B = 0°$, $\beta = 0°$. This often applies for luminaires that have some symmetry in their light distribution. However, for other luminaires, the maximum intensity may occur well away from the coordinate origin, as for luminaires specifically designed to control obtrusive light that have a cover glass that is substantially horizontal (see Figure D1(d), Appendix D).

If the reference direction and the direction of maximum intensity do not coincide in a given light distribution (e.g. the maximum intensity is not emitted from the floodlight perpendicular to the cover glass and the maximum intensity is at a value of β other than 0°) then the light distribution should be adjusted so that the two directions are in coincidence before reading off the intensity for the angle *p* calculated in accordance with Clause 5.3.2.1.



LEGEND:
— — — = horizontal plane containing point of interest, i.e. window of dwelling

FIGURE 5.3 ILLUSTRATION OF PHYSICAL ARRANGEMENT FOR EXAMPLE 5.3

5.4 DETERMINATION OF THRESHOLD INCREMENT

5.4.1 General Limiting values of threshold increment are recommended in Table 2.1. Such values apply for specific positions and viewing directions that are established as of importance with regard to the potential reduction in visibility that may be caused by the lighting installation. Assessment of compliance with the limiting values should be made in accordance with Clause 5.4.2.

5.4.2 Calculation of threshold increment The threshold increment (*TI*) for a particular position and viewing direction should be determined from the following equation:

$$TI = \frac{65\ L_v}{(\bar{L})^{0.8}} \qquad \ldots 5.7$$

where

$\bar{L}$ = the relevant value of adaptation luminance stated in Table 2.1, in candelas per square metre

L_v = the veiling luminance, defined by either Equation 5.8 or Equation 5.9, in candelas per square metre, as follows:

$$L_v = 3 \times 10^{-3}\ \Sigma\ \frac{E}{\theta^2} \qquad \ldots 5.8$$

$$L_v = 10\ \Sigma\ \frac{E}{\theta^2} \qquad \ldots 5.9$$

where

E = the illuminance at the observer's eye from one luminaire in the plane normal to the viewing direction, in lux

θ = the eccentricity of the luminaire from the observer's line of sight, in radians for Equation 5.8, and in degrees for Equation 5.9.

Σ indicates that the contribution from all luminaires is summed

Only luminaires that lie within the range 1.5° to 60° from the observer's line of sight should be taken into account in the calculation of *TI*.

To establish the veiling luminance, L_v, the illuminance at the observer's eye should be calculated for each of the luminaires in the field of view. The luminous intensities in the direction of the observer from each luminaire in the field of view should be separately determined from the luminous intensity distribution data for the luminaires (see Clause 5.3.2) and a calculation of the resulting illuminance, *E*, made using the following equation (see Figure 5.4):

$$E = \frac{I\ \cos\ \theta}{d^2} \qquad \ldots 5.10$$

where

I = the luminous intensity from the luminaire under evaluation, in the direction of the observer's eye, in candelas

θ = the angle subtended at the observer's eye between the direction of I and a plane normal to the viewing direction, in degrees

d = the distance from the luminaire to the observer, in metres

When evaluating the effects of the lighting installation on motorists using adjacent roads, the following observation conditions should be assumed:

(a) The driver's eye height should be taken as 1.5 m above the road surface.

(b) The driver's line of sight should be taken as parallel with the centre-line of the road and 1° down relative to the plane of the road surface.

(c) The cut-off angle resulting from the configuration of the vehicle windscreen should be as assumed in AS 1158.2.

These are the observation conditions assumed for the calculation of *TI* for road lighting installations in AS 1158.2.

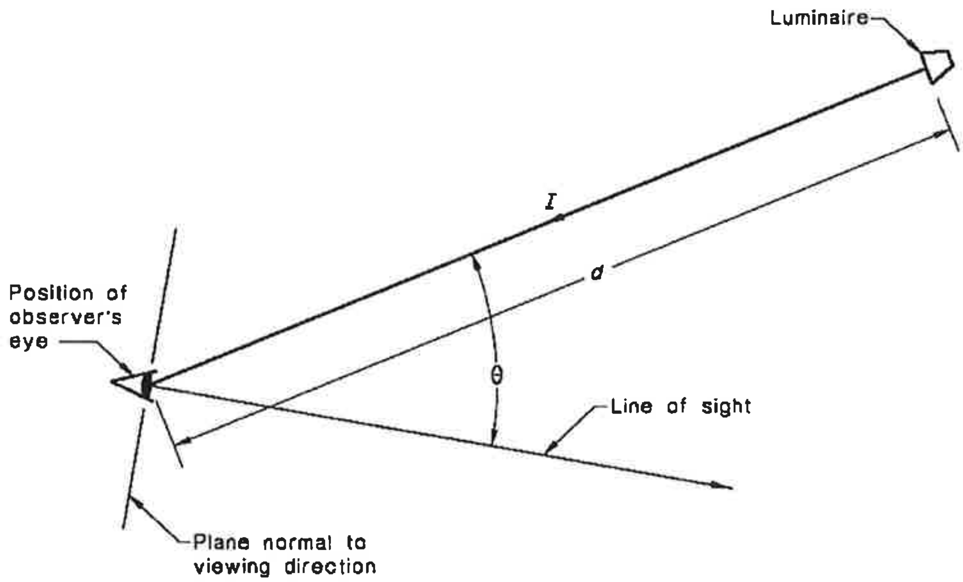
When evaluating the effects of the lighting installation on pedestrians, the following observation conditions should be assumed:

(i) The eye height of the pedestrian should be taken as 1.7 m above the footpath.

(ii) The pedestrian's line of sight should be taken as parallel with the direction of the footpath and 1° down relative to the plane of the footpath.

When evaluating the effects of the lighting installation on users of other transport signalling systems (e.g. rail, air) observation conditions should be established that are appropriate for the application having regard to normal paths of travel and directions of view. Such conditions may need to be determined in consultation with the relevant authority.

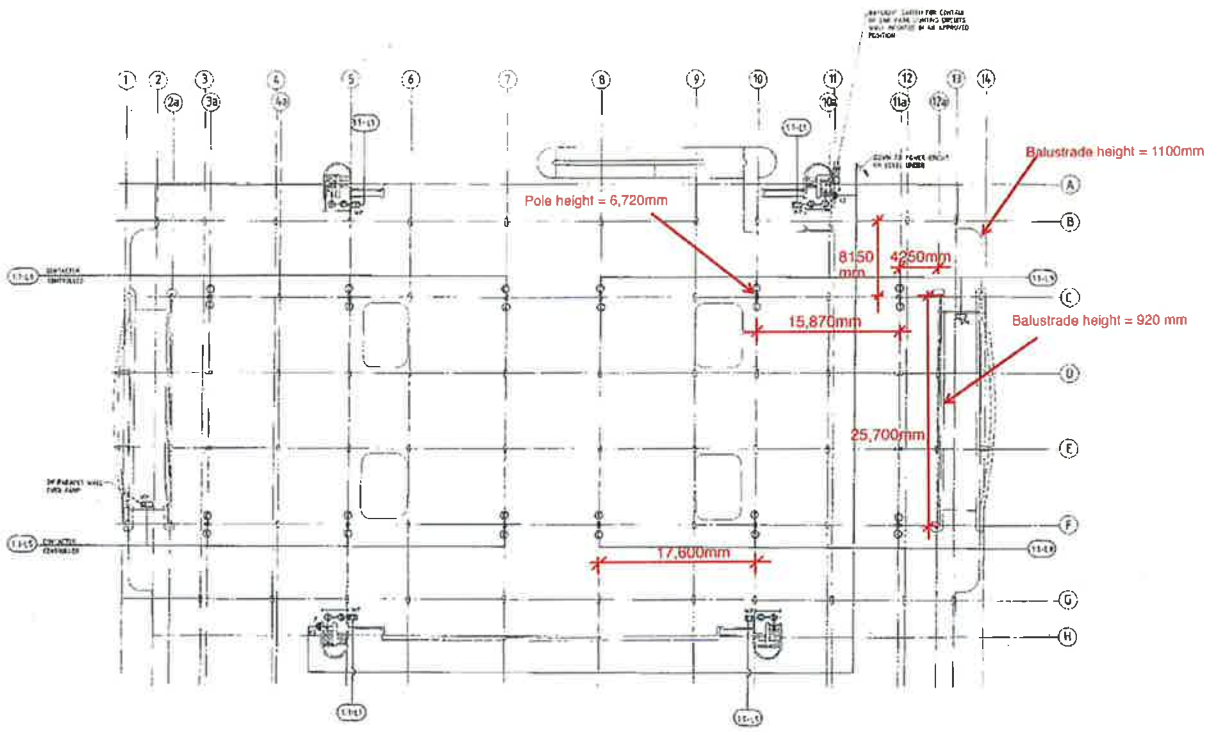
The calculation record should identify the specific types of evaluation made and indicate the positions and directions for which *TI* was calculated.



NOTE: The angle θ may have vertical and horizontal components, i.e. the luminaire may be displaced in azimuth relative to the line of sight.

FIGURE 5.4 PARAMETERS INVOLVED IN CALCULATING THE ILLUMINANCE AT THE OBSERVER'S EYE

9. APPENDIX B



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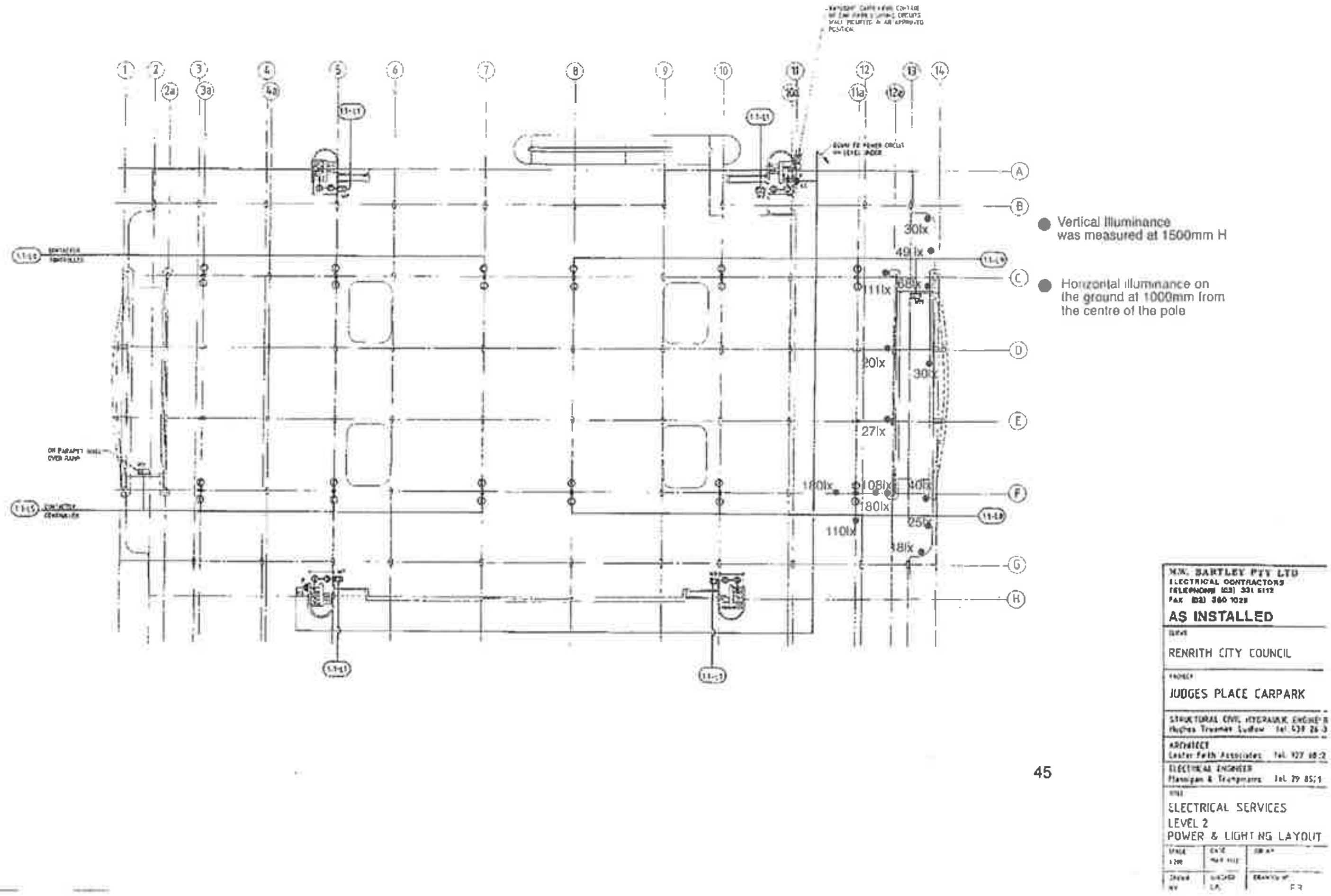
10. APPENDIX C


Vertical Illuminance was measured at 1500mm H
Horizontal illuminance on the ground at 1000mm from the centre of the pole
30lx
49lx
111lx
58lx
20lx
30lx
27lx
180lx
108lx
40lx
180lx
110lx
25lx
18lx
A
B
C
D
E
F
G
H
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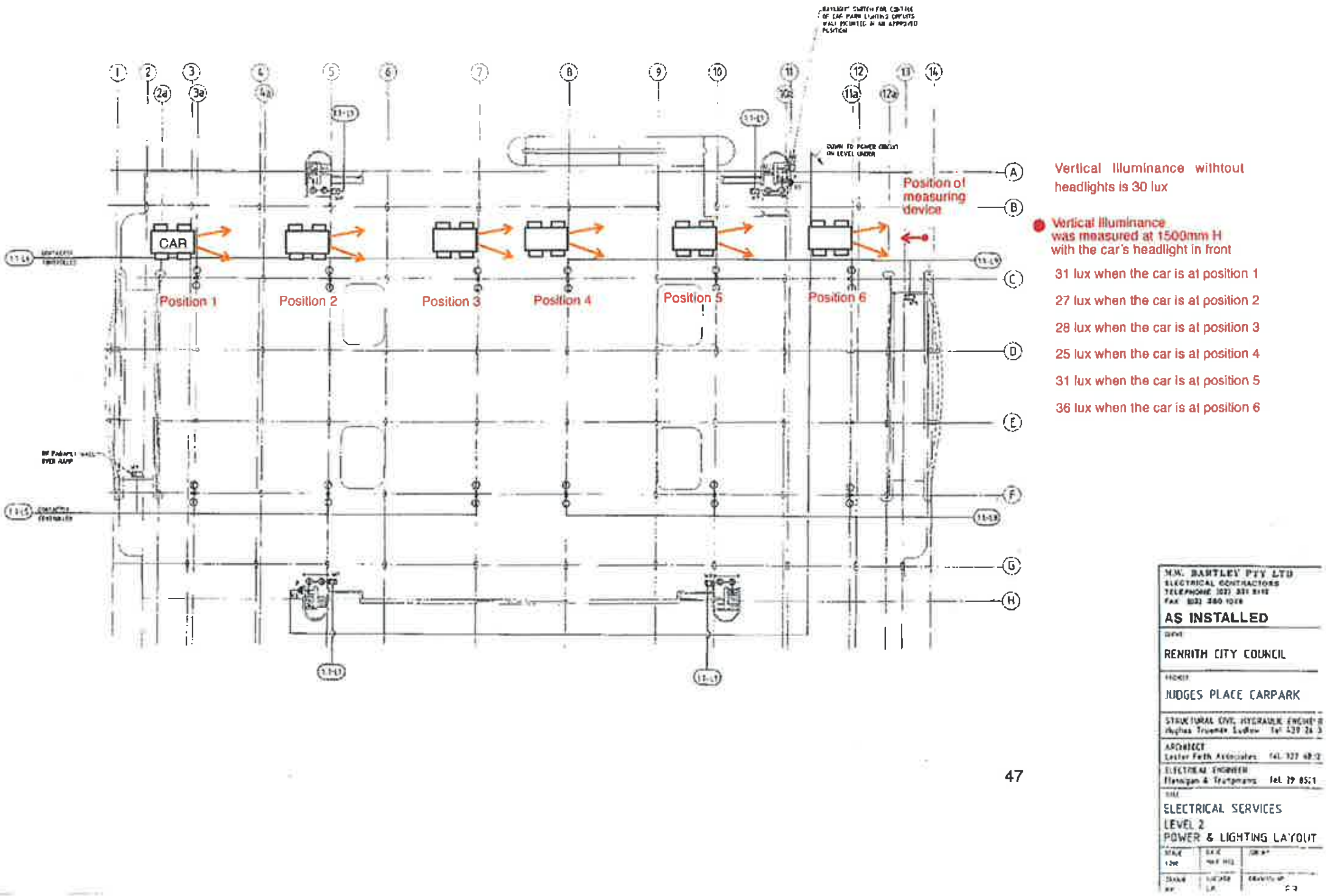
11. APPENDIX D


CAR
Position 1
Position 2
Position 3
Position 4
Position 5
Position 6
Position of measuring device
Vertical Illuminance withtout headlights is 30 lux
Vertical Illuminance was measured at 1500mm H with the car's headlight in front
31 lux when the car is at position 1
27 lux when the car is at position 2
28 lux when the car is at position 3
25 lux when the car is at position 4
31 lux when the car is at position 5
36 lux when the car is at position 6
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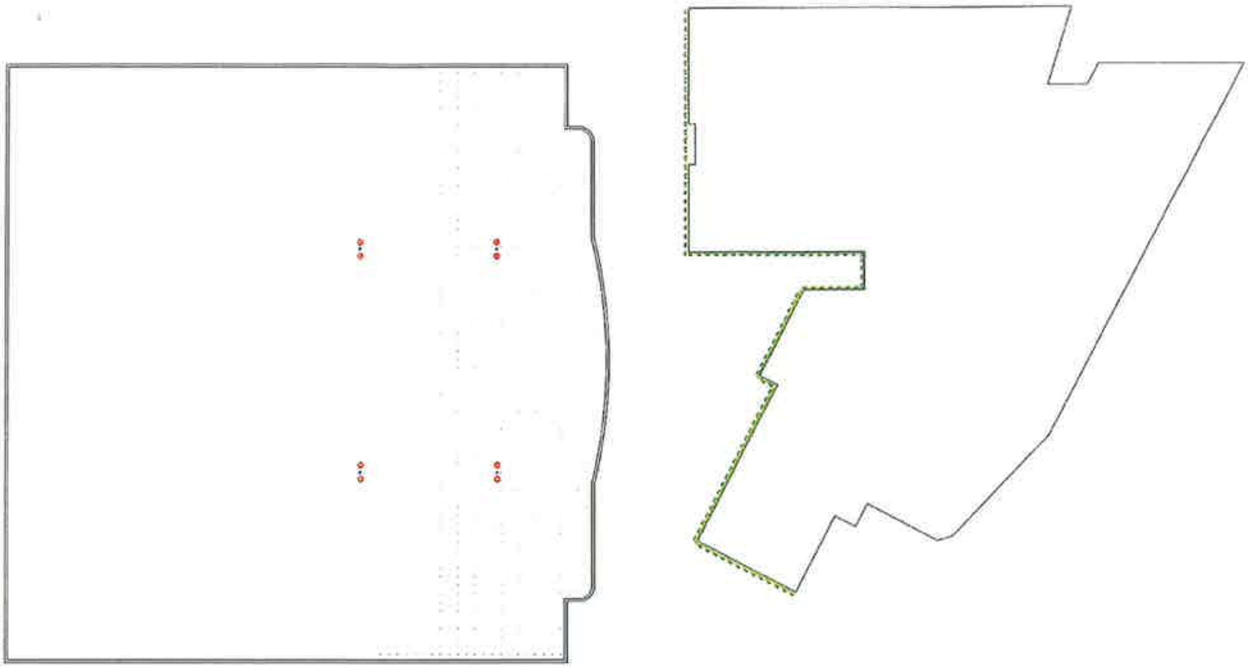
JUDGES PLACE CARPARK
ELECTRICAL SERVICES
LEVEL 2
POWER & LIGHTING LAYOUT

47

12. APPENDIX E



Luminaire Schedule					
Symbol	Qty	Label	LLF	Description	Lumens/Lamp
⊙	8	PT	0.650	CC25x5_400PMH-ED28	40000

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Min/Avg	Min/Max
model final_Carpark Ground	Illuminance	Lux	78.49	201.5	6.5	0.08	0.03
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	41.71	385	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	31.64	343	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	31.52	170	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	23.73	185	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	30.63	351	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	32.58	246	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	36.28	333	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	36.75	325	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Ill	Obtrusive Light - Ill	Lux	3.41	13.0	0.9	0.26	0.07
ObtrusiveLight_Bld Perimeter_Ill	Obtrusive Light - Ill	Lux	1.33	3.0	0.3	0.23	0.10
ObtrusiveLight_Bld Perimeter_Ill	Obtrusive Light - Ill	Lux	0.89	1.4	0.4	0.45	0.29
ObtrusiveLight_Bld Perimeter_Ill	Obtrusive Light - Ill	Lux	0.50	0.8	0.3	0.60	0.38
ObtrusiveLight_Bld Perimeter_Ill	Obtrusive Light - Ill	Lux	2.66	3.7	1.5	0.56	0.41
ObtrusiveLight_Bld Perimeter_Ill	Obtrusive Light - Ill	Lux	2.22	2.7	1.4	0.63	0.52
ObtrusiveLight_Bld Perimeter_Ill	Obtrusive Light - Ill	Lux	3.59	7.6	1.7	0.47	0.22
ObtrusiveLight_Bld Perimeter_Ill	Obtrusive Light - Ill	Lux	0.40	0.9	0.1	0.25	0.11

NOTES

1. VERTICAL & HORIZONTAL CALCULATION GRID 1000MM BY 1000MM
2. THE VALUES SHOWN ARE HORIZONTAL MAINTAINED ILLUMINANCE ON CARPARK GROUND AS PER SITE MEASUREMENT ON 4/6/2018 (APPROX)
3. LIGHT LOSS FACTOR (LLF) = 0.85 ADJ TO ACHIEVE APPROX ILLUM LEVELS MEASURED
4. DESIGN PREPARED BASED ON DETAILS PROVIDED AND APPROX SITE MEASUREMENTS
5. REFLECTANCE OF CARPARK GROUND 30% EST, ALL OTHER SURFACES AT 75% EST
6. IES FILE USED FROM KIM LIGHTING AS PER FILE NAME

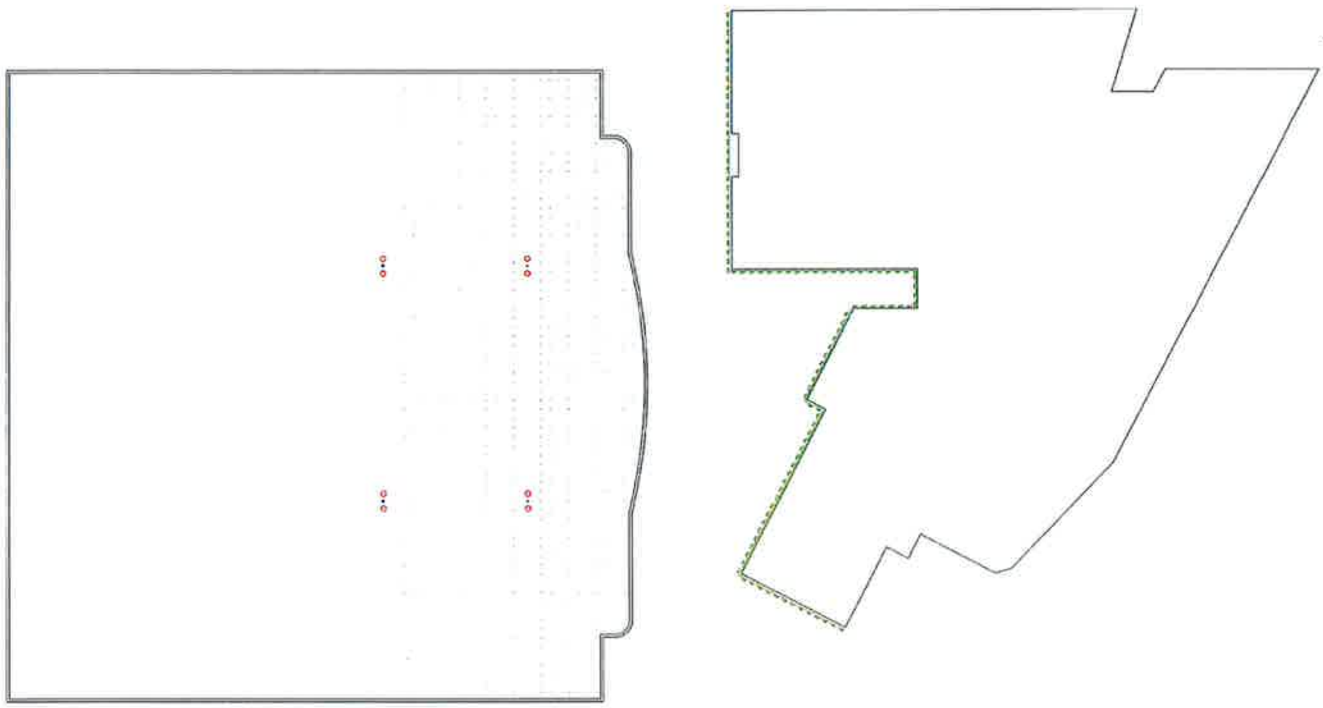
DESIGN BY BOW
M: 0422 645 167
E: bow@designbybow.com.au

Client: LAM CONSULTING ENGINEERS

Project: 21-25 Woodriff St Penrith

Drawn: BJ | Check: BJ | 7/06/2018
Scale: NTS
Drawing No. 20180607-01 | Rev. | Size A3

49



View_1:Plan View
Not to Scale

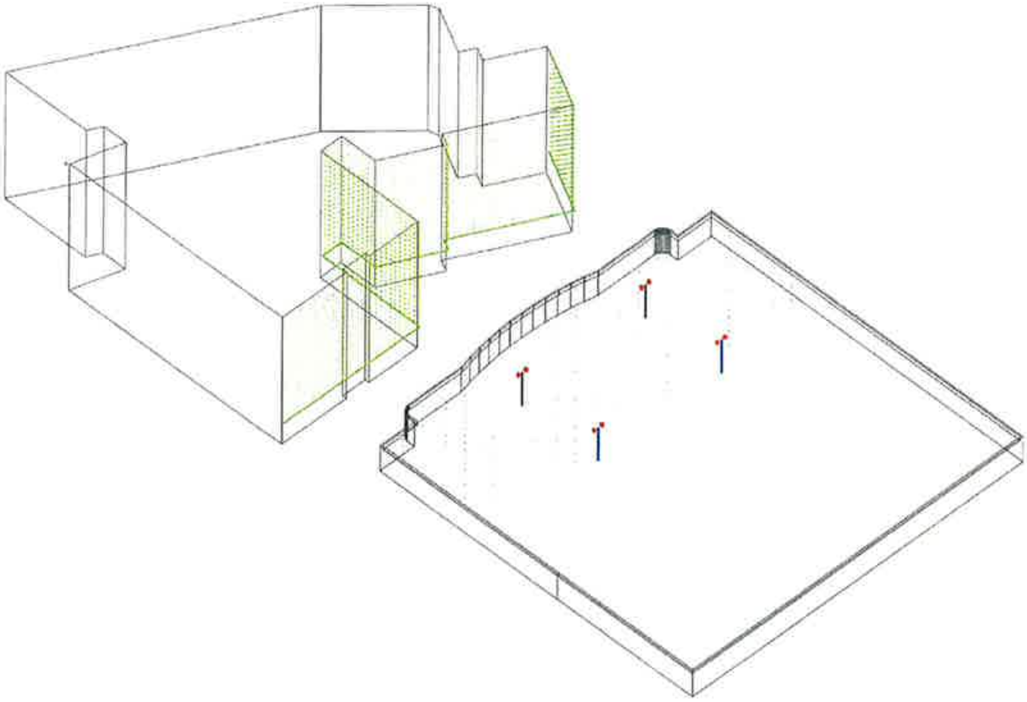
DESIGN BY BOW
M: 0422 645 167
E: bow@designbybow.com.au

Client: LAM CONSULTING ENGINEERS

Project: 21-25 Woodriff St Penrith

Drawn: BJ | Check: BJ | 7/06/2018
Scale: NTS
Drawing No. 20180607-01 | Rev. | Size A3

50

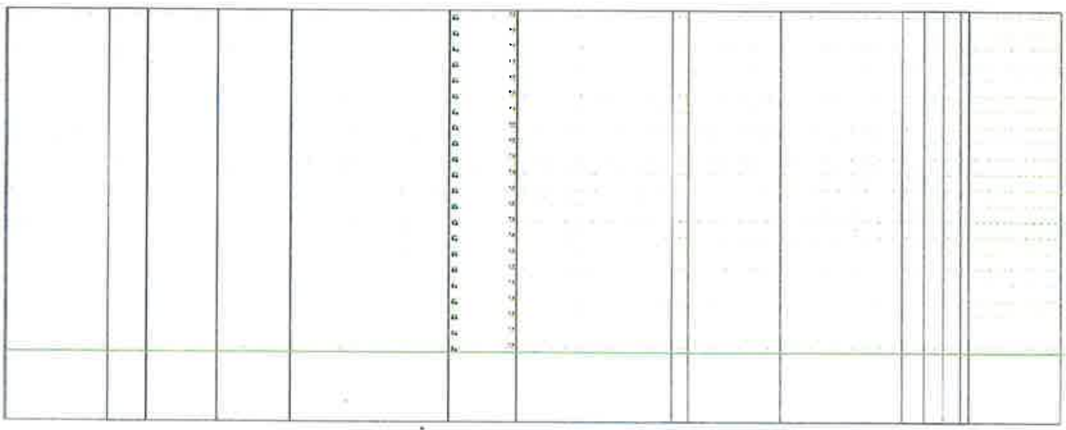


View_1:Iso View
Not to Scale

Client:	LAM CONSULTING ENGINEERS	Project:	21-25 Woodriff St Penrith	Drawn: BJ	Check: BJ	7/06/2018
				Scale: NTS		
				Drawing No. 20180607-01	Rev.	Size A3

DESIGN BY BOW
M: 0422 645 167
E: bow@designbybow.com.au

51

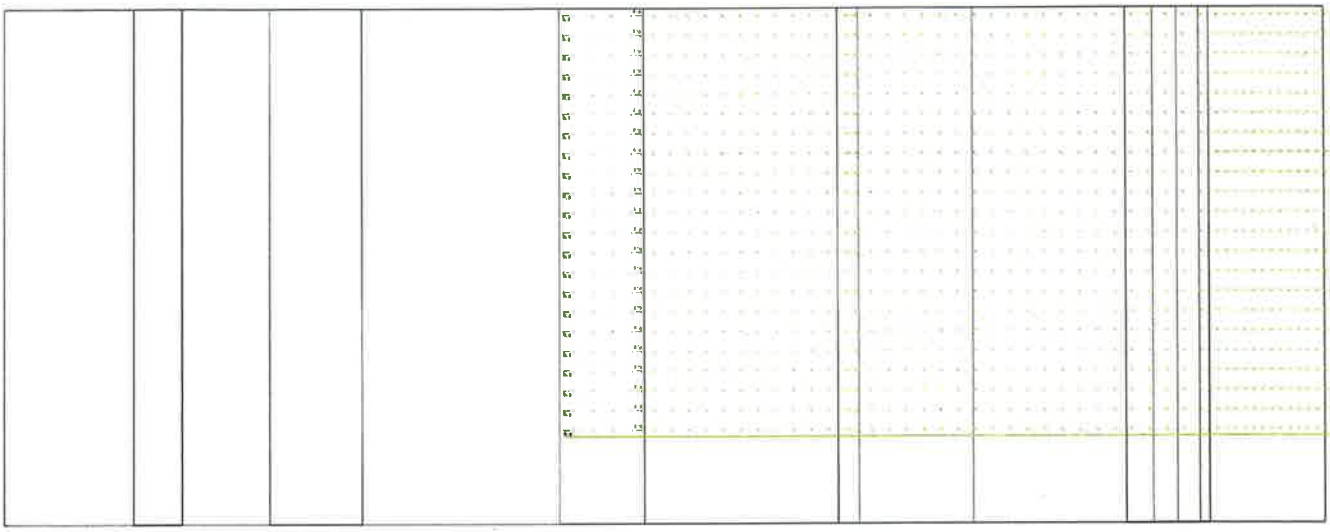


View_1:Elevation with Obt Calc Grid
Not to Scale

Client:	LAM CONSULTING ENGINEERS	Project:	21-25 Woodriff St Penrith	Drawn: BJ	Check: BJ	7/06/2018
				Scale: NTS		
				Drawing No. 20180607-01	Rev.	Size A3

DESIGN BY BOW
M: 0432 645 167
E: bow@designbybow.com.au

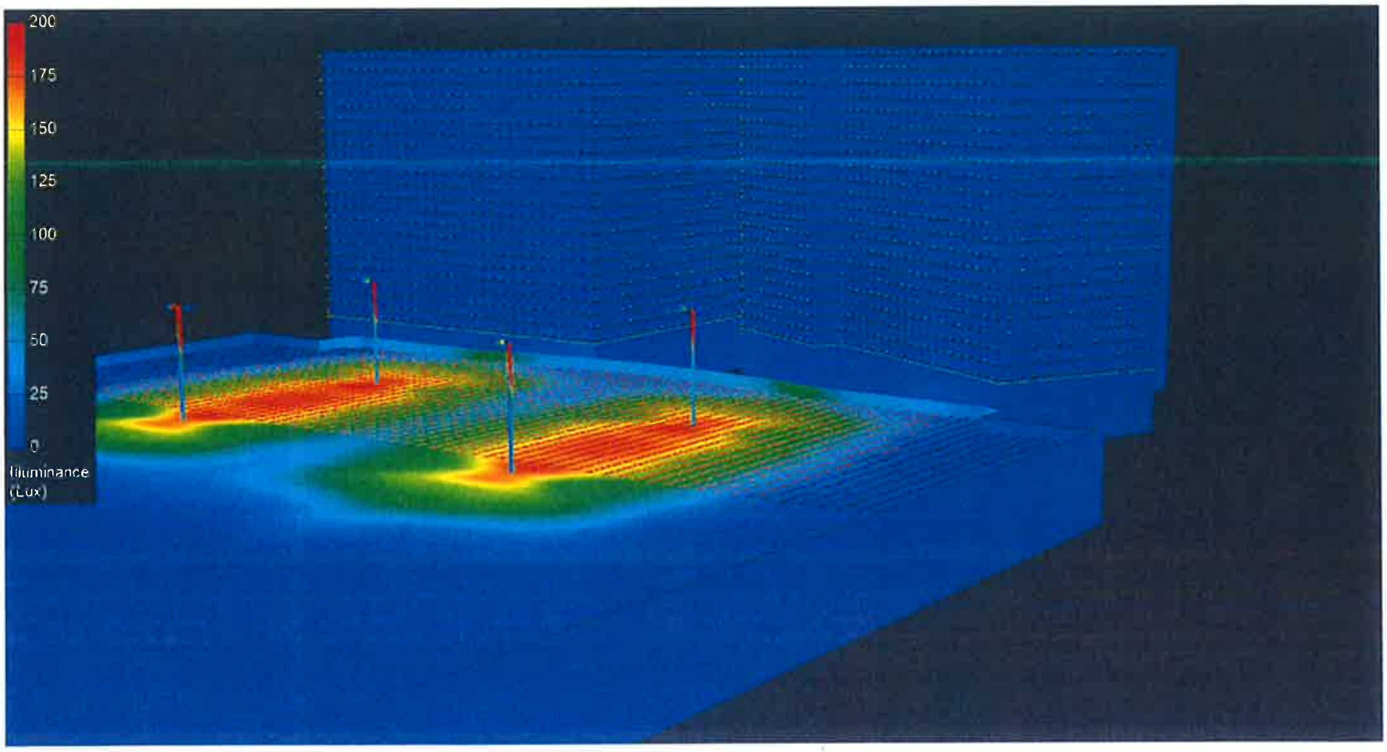
52



View_1:Elevation with Obt Calc Grid_1
Not to Scale

DESIGN BY BOW M: 0422 645 167 E: bow@designbybow.com.au	Client: LAM CONSULTING ENGINEERS	Project: 21-25 Woodriff St Penrith	Drawn: BJ · Check: BJ · 7/04/2018 Scale: NTS Drawing No. 20180607-01 · Rev. · Size A3

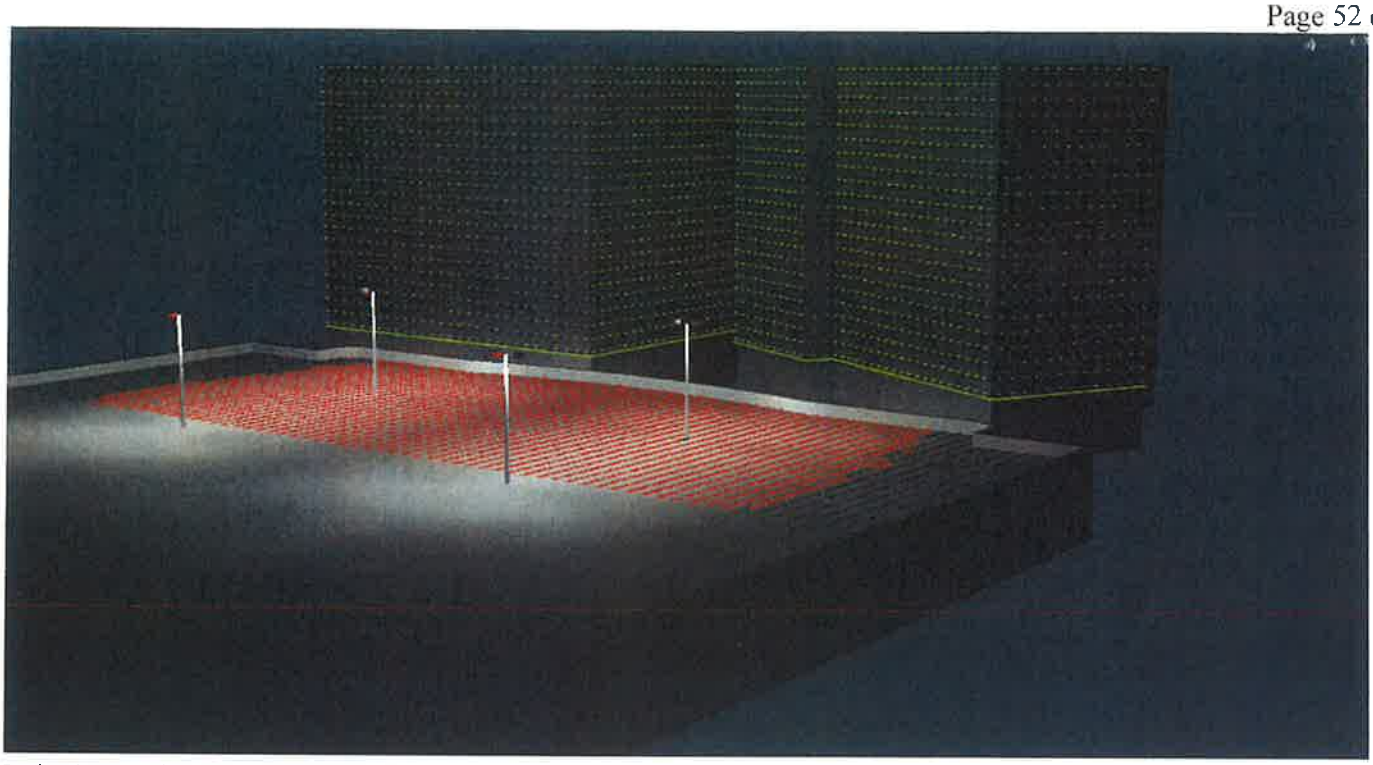
53



Render Image - View Name : RenderViewpoint_1

DESIGN BY BOW M: 0422 645 167 E: bow@designbybow.com.au	Client: LAM CONSULTING ENGINEERS	Project: 21-25 Woodriff St Penrith	Drawn: BJ · Check: BJ · 7/04/2018 Scale: NTS Drawing No. 20180607-01 · Rev. · Size A3

54



Render Image - View Name : RenderViewpoint_2

design by BOW — DESIGN BY BOW M: 0422 645 167 E: bow@designbybow.com.au	Client: LAM CONSULTING ENGINEERS	Project: 21-25 Woodriff St Penrith	Drawn: BJ Check: BJ 7/06/2018 Scale: NTS Drawing No. 20180607-01 Rev. Size A3

Obtrusive Light - Compliance Report

AS 4282-1997, Pre-Curfew, Commercial
Filename: obtrusive light calc
7/06/2018 9:23:52 AM

Illuminance

Maximum Allowable Value: 25 Lux

Calculations Tested (8):

Calculation Label	Test Results	Max. Illum.
ObtrusiveLight_Bld Perimeter_Ill_Seg1	**PASS**	13.0
ObtrusiveLight_Bld Perimeter_Ill_Seg2	**PASS**	3.0
ObtrusiveLight_Bld Perimeter_Ill_Seg3	**PASS**	1.4
ObtrusiveLight_Bld Perimeter_Ill_Seg4	**PASS**	0.8
ObtrusiveLight_Bld Perimeter_Ill_Seg5	**PASS**	3.7
ObtrusiveLight_Bld Perimeter_Ill_Seg6	**PASS**	2.7
ObtrusiveLight_Bld Perimeter_Ill_Seg7	**PASS**	7.6
ObtrusiveLight_Bld Perimeter_Ill_Seg8	**PASS**	0.9

Luminous Intensity (Cd) Per Luminaire

Maximum Allowable Value: 7500 Cd
Control Angle: 83 Degrees

Luminaire Locations Tested (8)
Test Results: **PASS**

design by BOW — DESIGN BY BOW M: 0422 645 167 E: bow@designbybow.com.au	Client: LAM CONSULTING ENGINEERS	Project: 21-25 Woodriff St Penrith	Drawn: BJ Check: BJ 7/06/2018 Scale: NTS Drawing No. 20180607-01 Rev. Size A3

Obtrusive Light - Compliance Report

AS 4282-1997, Pre-Curfew, Commercial
Filename: obtrusive light calc
7/06/2018 9:23:52 AM

Illuminance

Maximum Allowable Value: 25 Lux

Calculations Tested (8):

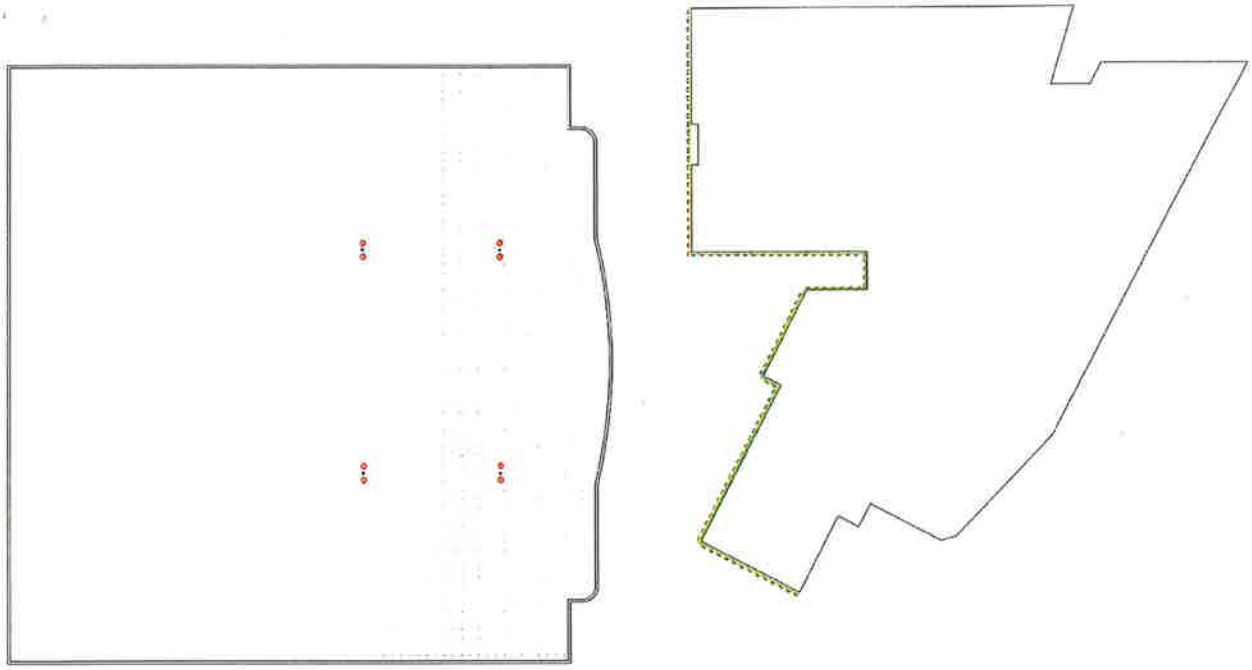
Calculation Label	Test Results	Max. Illum.
ObtrusiveLight_Bld Perimeter_Ill_Seg1	**PASS**	13.0
ObtrusiveLight_Bld Perimeter_Ill_Seg2	**PASS**	3.0
ObtrusiveLight_Bld Perimeter_Ill_Seg3	**PASS**	1.4
ObtrusiveLight_Bld Perimeter_Ill_Seg4	**PASS**	0.8
ObtrusiveLight_Bld Perimeter_Ill_Seg5	**PASS**	3.7
ObtrusiveLight_Bld Perimeter_Ill_Seg6	**PASS**	2.7
ObtrusiveLight_Bld Perimeter_Ill_Seg7	**PASS**	7.6
ObtrusiveLight_Bld Perimeter_Ill_Seg8	**PASS**	0.9

Luminous Intensity (Cd) Per Luminaire

Maximum Allowable Value: 7500 Cd
Control Angle: 83 Degrees

Luminaire Locations Tested (8)
Test Results: **PASS**

13. APPENDIX F



Luminaire Schedule					
Symbol	Qty	Label	LLF	Description	Lumens/Lamp
	8	PT	0.850	CC25x5_400FHH-ED28	40000

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Min/Avg	Min/Max
model Final_Carpark Ground	Illuminance	Lux	78.49	201.5	4.5	0.08	0.03
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	41.71	385	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	31.64	343	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	21.32	170	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	23.73	185	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	30.62	251	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	32.98	246	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	36.28	332	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Cd_	Obtrusive Light - Cd	N.A.	26.75	325	0	0.00	0.00
ObtrusiveLight_Bld Perimeter_Il	Obtrusive Light - Il	Lux	3.41	13.0	0.9	0.26	0.07
ObtrusiveLight_Bld Perimeter_Il	Obtrusive Light - Il	Lux	1.33	3.0	0.3	0.23	0.10
ObtrusiveLight_Bld Perimeter_Il	Obtrusive Light - Il	Lux	0.89	1.4	0.4	0.45	0.29
ObtrusiveLight_Bld Perimeter_Il	Obtrusive Light - Il	Lux	0.50	0.8	0.3	0.60	0.38
ObtrusiveLight_Bld Perimeter_Il	Obtrusive Light - Il	Lux	2.66	3.7	1.5	0.56	0.41
ObtrusiveLight_Bld Perimeter_Il	Obtrusive Light - Il	Lux	2.22	2.7	1.4	0.63	0.52
ObtrusiveLight_Bld Perimeter_Il	Obtrusive Light - Il	Lux	3.59	7.6	1.7	0.47	0.22
ObtrusiveLight_Bld Perimeter_Il	Obtrusive Light - Il	Lux	0.40	0.9	0.1	0.25	0.11

NOTES

1. VERTICAL & HORIZONTAL CALCULATION GRID 1000MM BY 1000MM
2. THE VALUES SHOWN ARE HORIZONTAL MAINTAINED ILLUMINANCE ON CARPARK GROUND AS PER SITE MEASUREMENT ON 4/6/2018 (APPROX)
3. LIGHT LOSS FACTOR (LLF) = 0.85 ADJ TO ACHIEVE APPROX ILLUM LEVELS MEASURED
4. DESIGN PREPARED BASED ON DETAILS PROVIDED AND APPROX SITE MEASUREMENTS
5. REFLECTANCE OF CARPARK GROUND 30% EST, ALL OTHER SURFACES AT 75% EST
6. IES FILE USED FROM KIM LIGHTING AS PER FILE NAME

DESIGN BY BOW
M: 0422 645 167
E: bow@designbybow.com.au

Client: LAM CONSULTING ENGINEERS

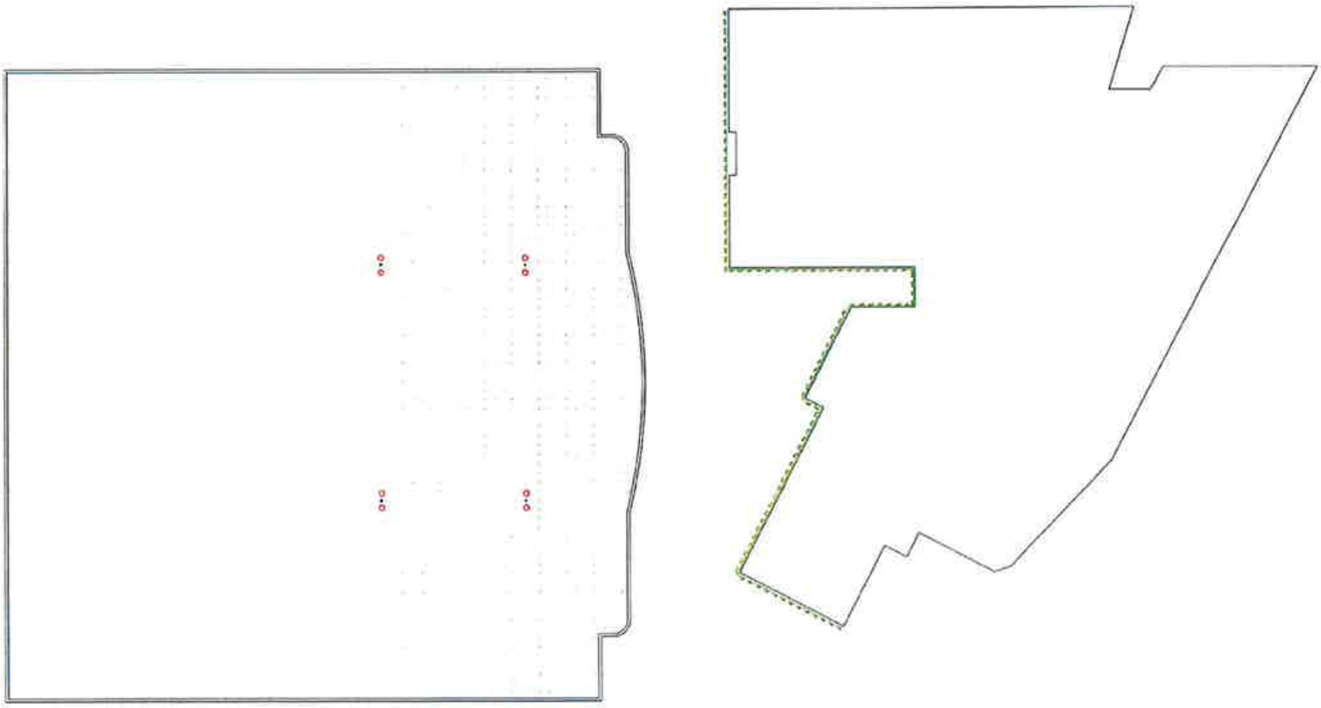
Project: 21-25 Woodriff St Penrith

Drawn: BJ | Check: BJ | 7/06/2018

Scale: NTS

Drawing No. 20180607-02 | Rev. | Size A3

59



View_1:Plan View
Not to Scale

DESIGN BY BOW
M: 0422 645 167
E: bow@designbybow.com.au

Client: LAM CONSULTING ENGINEERS

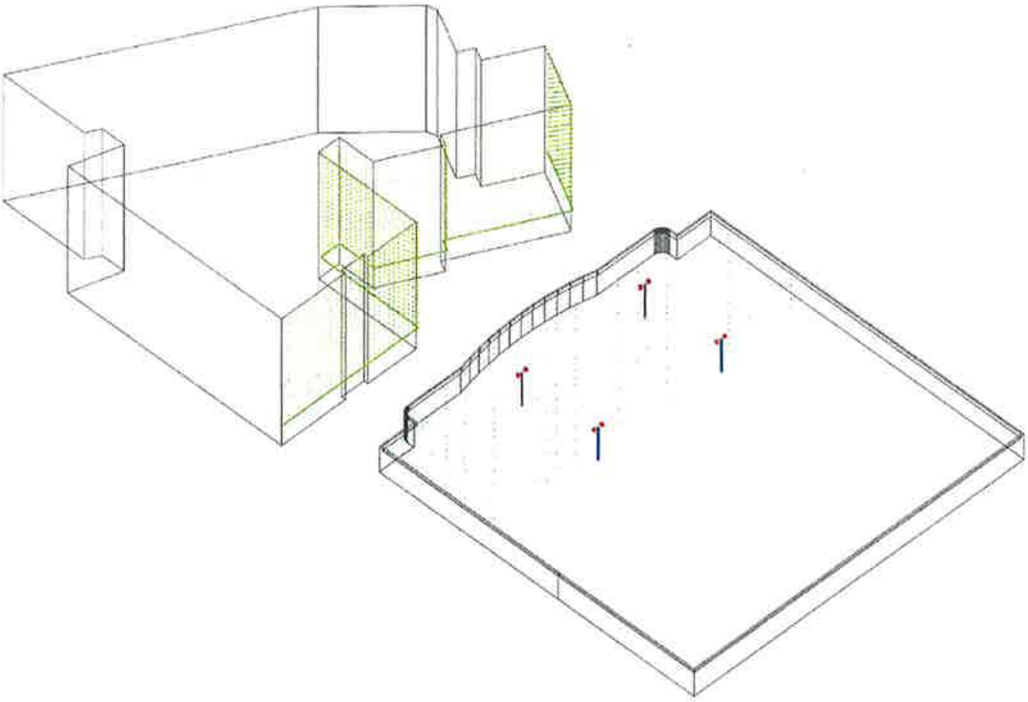
Project: 21-25 Woodriff St Penrith

Drawn: BJ | Check: BJ | 7/06/2018

Scale: NTS

Drawing No. 20180607-02 | Rev. | Size A3

60



View_1:Iso View
Not to Scale

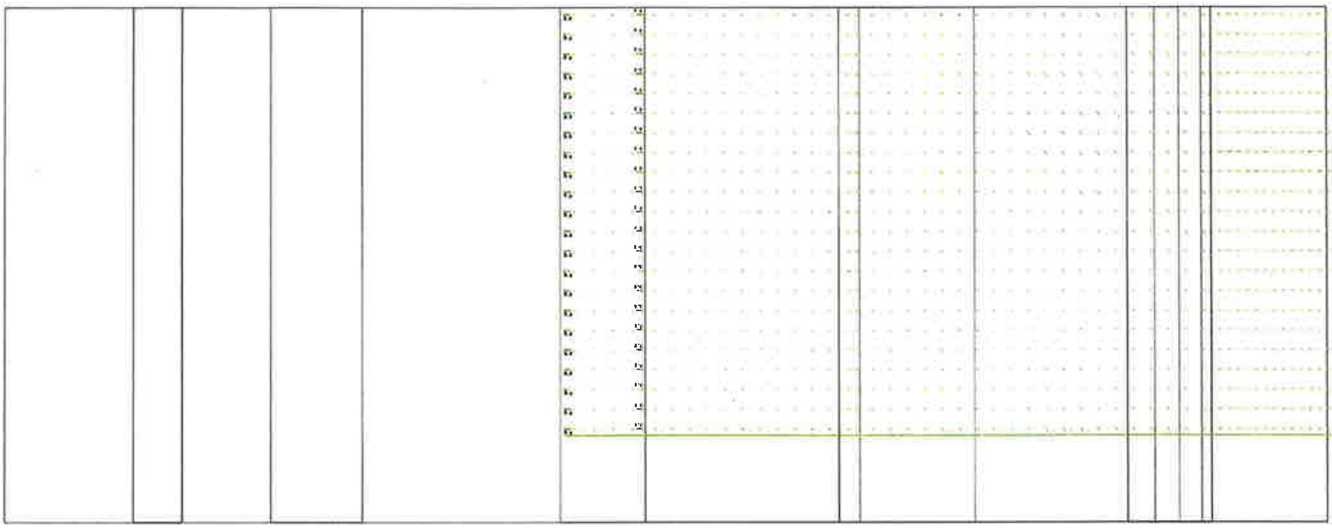
DESIGN BY BOW M: 0422 645 167 E: bow@designbybow.com.au	Client: LAM CONSULTING ENGINEERS	Project: 21-25 Woodriff St Penrith	Drawn: BJ Check: BJ 7/06/2018 Scale: NTS Drawing No. 20180607-02 Rev. Size A3

61

View_1:Elevation with Obt Calc Grid
Not to Scale

DESIGN BY BOW M: 0422 645 167 E: bow@designbybow.com.au	Client: LAM CONSULTING ENGINEERS	Project: 21-25 Woodriff St Penrith	Drawn: BJ Check: BJ 7/06/2018 Scale: NTS Drawing No. 20180607-02 Rev. Size A3

62



View_1:Elevation with Obt Calc Grid_1
Not to Scale

design by BOW

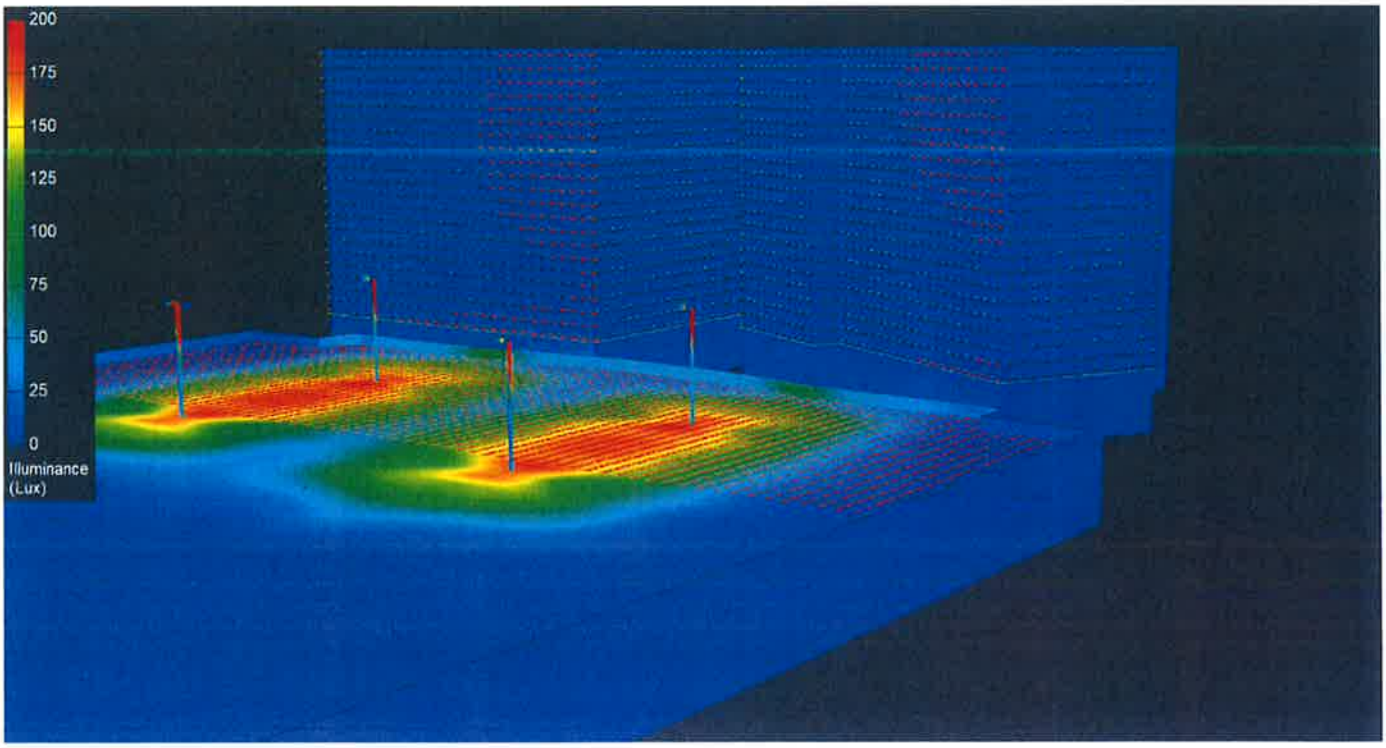
DESIGN BY BOW
M: 0422 645 167
E: bow@designbybow.com.au

Client: LAM CONSULTING ENGINEERS

Project: 21-25 Woodriff St Penrith

Drawn: BJ | Check: BJ | 7/06/2018
Scale: NTS
Drawing No. 20180607-02 | Rev. | Size A3

63



Render Image - View Name : RenderViewpoint_4

design by BOW

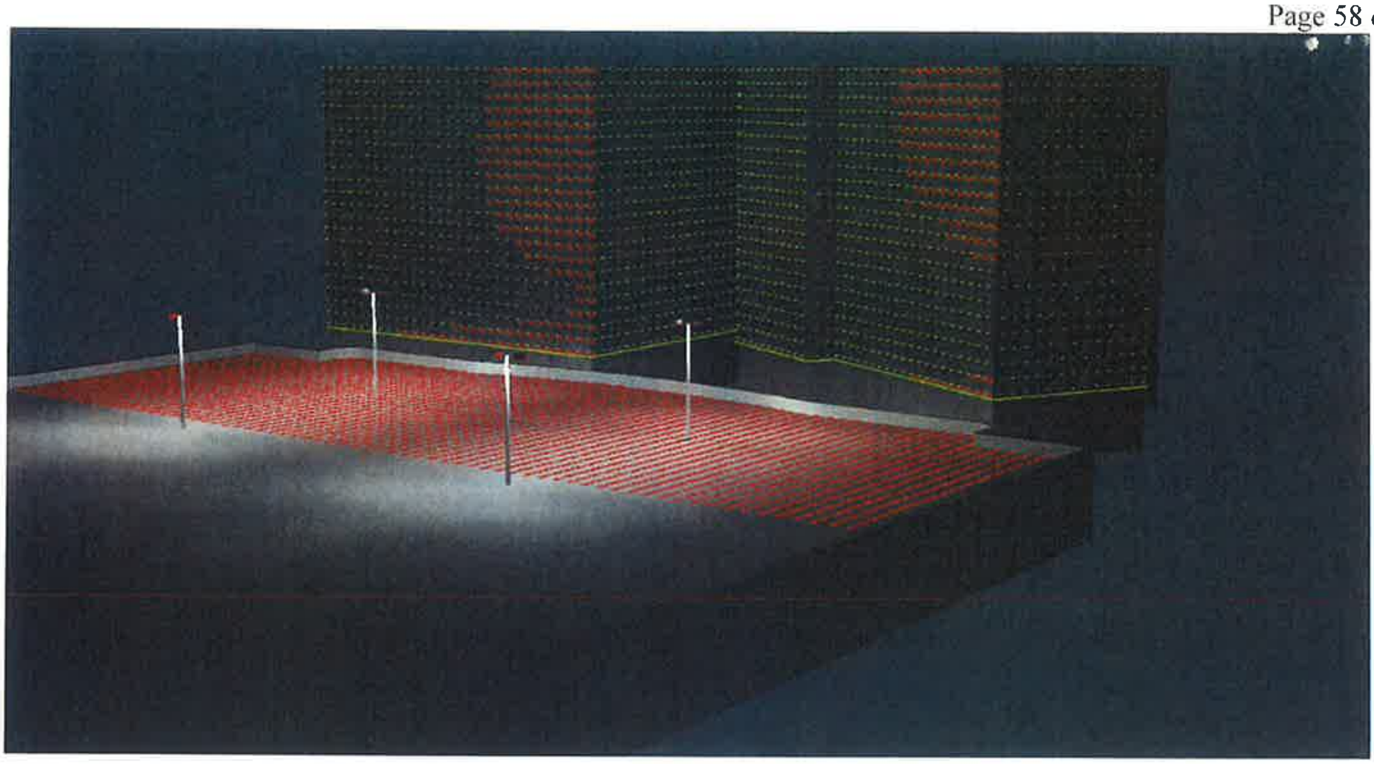
DESIGN BY BOW
M: 0422 645 167
E: bow@designbybow.com.au

Client: LAM CONSULTING ENGINEERS

Project: 21-25 Woodriff St Penrith

Drawn: BJ | Check: BJ | 7/06/2018
Scale: NTS
Drawing No. 20180607-02 | Rev. | Size A3

64



Render Image - View Name : RenderViewpoint_3

design by B W	DESIGN BY BOW M: 0422 645 167 E: bow@designbybow.com.au	Client: LAM CONSULTING ENGINEERS	Project: 21-25 Woodriff St Penrith	Drawn: BJ Check: BJ 7/06/2018 Scale: NTS Drawing No. 20180607-02 Rev. Size A3

Obtrusive Light - Compliance Report

AS 4282-1997, Post-Curfew, Commercial
Filename: post curfew obtrusive light calc
7/06/2018 2:31:32 PM

Illuminance

Maximum Allowable Value: 4 Lux

Calculations Tested (8):

Calculation Label	Test Results	Max. Illum.
ObtrusiveLight_Bld Perimeter_Ill_Seg1	FAIL	13.0
ObtrusiveLight_Bld Perimeter_Ill_Seg2	PASS	3.0
ObtrusiveLight_Bld Perimeter_Ill_Seg3	PASS	1.4
ObtrusiveLight_Bld Perimeter_Ill_Seg4	PASS	0.8
ObtrusiveLight_Bld Perimeter_Ill_Seg5	PASS	3.7
ObtrusiveLight_Bld Perimeter_Ill_Seg6	PASS	2.7
ObtrusiveLight_Bld Perimeter_Ill_Seg7	FAIL	7.6
ObtrusiveLight_Bld Perimeter_Ill_Seg8	PASS	0.9

Luminous Intensity (Cd) At Vertical Planes

Maximum Allowable Value: 2500 Cd

Calculations Tested (8):

Calculation Label	Test Results
ObtrusiveLight_Bld Perimeter_Cd_Seg1	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg2	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg3	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg4	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg5	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg6	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg7	PASS
ObtrusiveLight_Bld Perimeter_Cd_Seg8	PASS

design by B W	DESIGN BY BOW M: 0422 645 167 E: bow@designbybow.com.au	Client: LAM CONSULTING ENGINEERS	Project: 21-25 Woodriff St Penrith	Drawn: BJ Check: BJ 7/06/2018 Scale: NTS Drawing No. 20180607-02 Rev. Size A3

Obtrusive Light - Compliance Report

AS 4282-1997, Post-Curfew, Commercial
Filename: post curfew obtrusive light calc
7/06/2018 2:31:32 PM

Illuminance

Maximum Allowable Value: 4 Lux

Calculations Tested (8):

Calculation Label	Test Results	Max. Illum.
ObtrusiveLight_Bld Perimeter_Ill_Seg1	FAIL	13.0
ObtrusiveLight_Bld Perimeter_Ill_Seg2	PASS	3.0
ObtrusiveLight_Bld Perimeter_Ill_Seg3	PASS	1.4
ObtrusiveLight_Bld Perimeter_Ill_Seg4	PASS	0.8
ObtrusiveLight_Bld Perimeter_Ill_Seg5	PASS	3.7
ObtrusiveLight_Bld Perimeter_Ill_Seg6	PASS	2.7
ObtrusiveLight_Bld Perimeter_Ill_Seg7	FAIL	7.6
ObtrusiveLight_Bld Perimeter_Ill_Seg8	PASS	0.9

Failed Meter Locations (>250, only first 250 shown):

Calculation Label	Lux	Meter Coords
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.1	80.7, 55.65, 6.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.1	80.7, 50.65, 7.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.1	80.7, 49.65, 8.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.1	80.7, 52.65, 10.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.1	80.7, 54.65, 11.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.1	80.7, 57.65, 13.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.1	80.7, 58.65, 15.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.1	80.7, 59.65, 19.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.1	80.7, 59.65, 20.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.1	80.7, 58.65, 23.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.1	80.7, 57.65, 25.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 68.65, 4.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 54.65, 6.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 48.65, 7.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 49.65, 7.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 48.65, 8.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 48.65, 9.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 49.65, 9.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 51.65, 10.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 53.65, 11.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 55.65, 12.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 56.65, 13.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 58.65, 16.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 59.65, 18.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 58.65, 21.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 58.65, 22.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 57.65, 23.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 56.65, 24.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 57.65, 24.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.2	80.7, 56.65, 25.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.3	80.7, 62.65, 5.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.3	80.7, 53.65, 6.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.3	80.7, 49.65, 10.75
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ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.3	80.7, 52.65, 11.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.3	80.7, 54.65, 12.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.3	80.7, 56.65, 14.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.3	80.7, 57.65, 14.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.3	80.7, 57.65, 15.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.3	80.7, 58.65, 17.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.3	80.7, 58.65, 18.75
ObtrusiveLight_Bld Perimeter_Ill_Seg1	4.3	80.7, 58.65, 19.75

ObtrusiveLight_Bld Perimeter_III_Seg1	4.3	80.7, 58.65, 20.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.3	80.7, 57.65, 22.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.3	80.7, 55.65, 25.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 52.65, 6.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 48.65, 10.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 51.65, 11.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 55.65, 13.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 56.65, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 57.65, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 57.65, 17.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 57.65, 18.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 57.65, 19.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 57.65, 20.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 57.65, 21.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 56.65, 22.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 56.65, 23.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.4	80.7, 55.65, 24.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.5	80.7, 51.65, 6.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.5	80.7, 53.65, 12.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.5	80.7, 54.65, 13.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.5	80.7, 55.65, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.5	80.7, 56.65, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.5	80.7, 56.65, 18.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.5	80.7, 56.65, 20.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.5	80.7, 56.65, 21.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.5	80.7, 55.65, 23.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.5	80.7, 54.65, 24.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.5	80.7, 54.65, 25.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.6	80.7, 67.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.6	80.7, 50.65, 11.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.6	80.7, 52.65, 12.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.6	80.7, 55.65, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.6	80.7, 56.65, 17.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.6	80.7, 55.65, 21.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.6	80.7, 55.65, 22.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.6	80.7, 54.65, 23.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.6	80.7, 53.65, 24.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.6	80.7, 52.65, 25.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.6	80.7, 53.65, 25.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 61.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 50.65, 6.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 48.65, 11.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 49.65, 11.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 53.65, 13.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 54.65, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 55.65, 17.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 55.65, 19.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 56.65, 19.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 55.65, 20.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 54.65, 22.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 53.65, 23.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 52.65, 24.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.7	80.7, 51.65, 25.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.8	80.7, 51.65, 12.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.8	80.7, 53.65, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.8	80.7, 54.65, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.8	80.7, 54.65, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.8	80.7, 55.65, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.8	80.7, 55.65, 18.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.8	80.7, 54.65, 19.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.8	80.7, 54.65, 20.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.8	80.7, 54.65, 21.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.8	80.7, 53.65, 22.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.8	80.7, 50.65, 25.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 48.65, 6.75

ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 49.65, 6.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 49.65, 12.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 50.65, 12.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 52.65, 13.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 54.65, 17.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 54.65, 18.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 53.65, 19.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 53.65, 20.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 53.65, 21.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 52.65, 22.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 51.65, 23.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 52.65, 23.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 50.65, 24.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 51.65, 24.75
ObtrusiveLight_Bld Perimeter_III_Seg1	4.9	80.7, 49.65, 25.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.0	80.7, 66.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.0	80.7, 60.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.0	80.7, 51.65, 13.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.0	80.7, 52.65, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.0	80.7, 53.65, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.0	80.7, 53.65, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.0	80.7, 53.65, 17.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.0	80.7, 50.65, 23.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.0	80.7, 49.65, 24.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.0	80.7, 48.65, 25.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.1	80.7, 48.65, 12.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.1	80.7, 50.65, 13.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.1	80.7, 52.65, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.1	80.7, 53.65, 18.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.1	80.7, 52.65, 19.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.1	80.7, 52.65, 20.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.1	80.7, 51.65, 21.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.1	80.7, 52.65, 21.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.1	80.7, 51.65, 22.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.1	80.7, 49.65, 23.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 59.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 48.65, 13.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 49.65, 13.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 50.65, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 51.65, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 51.65, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 52.65, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 52.65, 17.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 52.65, 18.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 51.65, 19.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 50.65, 20.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 51.65, 20.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 49.65, 22.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 50.65, 22.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 48.65, 23.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.2	80.7, 48.65, 24.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.3	80.7, 49.65, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.3	80.7, 51.65, 17.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.3	80.7, 51.65, 18.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.3	80.7, 50.65, 19.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.3	80.7, 49.65, 21.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.3	80.7, 50.65, 21.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.4	80.7, 65.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.4	80.7, 48.65, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.4	80.7, 49.65, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.4	80.7, 50.65, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.4	80.7, 50.65, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.4	80.7, 51.65, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.4	80.7, 49.65, 18.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.4	80.7, 50.65, 18.75

ObtrusiveLight_Bld Perimeter_III_Seg1	5.4	80.7, 49.65, 19.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.4	80.7, 49.65, 20.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.4	80.7, 48.65, 21.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.4	80.7, 48.65, 22.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.5	80.7, 58.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.5	80.7, 48.65, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.5	80.7, 49.65, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.5	80.7, 49.65, 17.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.5	80.7, 50.65, 17.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.5	80.7, 48.65, 20.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.6	80.7, 48.65, 17.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.6	80.7, 48.65, 18.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.6	80.7, 48.65, 19.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.7	80.7, 64.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.7	80.7, 57.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.7	80.7, 48.65, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.8	80.7, 54.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.8	80.7, 56.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	5.9	80.7, 55.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	6.0	80.7, 53.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	6.1	80.7, 63.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	6.1	80.7, 52.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	6.4	80.7, 51.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	6.5	80.7, 62.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	6.7	80.7, 50.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	6.9	80.7, 61.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	7.0	80.7, 49.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	7.1	80.7, 48.65, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg1	7.4	80.7, 60.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	7.8	80.7, 59.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	8.2	80.7, 58.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	8.5	80.7, 57.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	8.6	80.7, 56.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	8.7	80.7, 55.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	8.8	80.7, 54.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	9.1	80.7, 53.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	9.8	80.7, 52.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	10.7	80.7, 51.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	11.9	80.7, 50.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	12.6	80.7, 49.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg1	13.0	80.7, 48.65, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.1	82.807, 17.537, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.1	82.807, 17.537, 13.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.1	84.185, 20.202, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.1	84.644, 21.091, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.1	86.48, 24.644, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.1	85.562, 22.867, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.2	82.348, 16.648, 13.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.2	83.726, 19.314, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.2	83.267, 18.425, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.2	84.185, 20.202, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.2	85.103, 21.979, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.2	84.644, 21.091, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.3	86.021, 23.756, 4.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.3	81.889, 15.76, 13.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.3	82.807, 17.537, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.3	82.348, 16.648, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.3	83.726, 19.314, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.4	83.267, 18.425, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.4	82.807, 17.537, 15.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.4	84.185, 20.202, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.4	83.726, 19.314, 16.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.5	82.348, 16.648, 5.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.5	81.889, 15.76, 14.75
ObtrusiveLight_Bld Perimeter_III_Seg7	4.5	83.267, 18.425, 16.75

ObtrusiveLight_Bld Perimeter_Ill_Seg7	4.6	85.562, 22.867, 4.75
ObtrusiveLight_Bld Perimeter_Ill_Seg7	4.6	82.348, 16.648, 15.75
ObtrusiveLight_Bld Perimeter_Ill_Seg7	4.6	81.889, 15.76, 15.75
ObtrusiveLight_Bld Perimeter_Ill_Seg7	4.6	82.807, 17.537, 16.75
ObtrusiveLight_Bld Perimeter_Ill_Seg7	4.8	85.103, 21.979, 4.75
ObtrusiveLight_Bld Perimeter_Ill_Seg7	5.0	81.889, 15.76, 5.75
ObtrusiveLight_Bld Perimeter_Ill_Seg7	5.1	84.644, 21.091, 4.75
ObtrusiveLight_Bld Perimeter_Ill_Seg7	5.4	84.185, 20.202, 4.75
ObtrusiveLight_Bld Perimeter_Ill_Seg7	5.6	83.726, 19.314, 4.75
ObtrusiveLight_Bld Perimeter_Ill_Seg7	6.1	83.267, 18.425, 4.75
ObtrusiveLight_Bld Perimeter_Ill_Seg7	6.6	82.807, 17.537, 4.75
ObtrusiveLight_Bld Perimeter_Ill_Seg7	7.1	82.348, 16.648, 4.75
ObtrusiveLight_Bld Perimeter_Ill_Seg7	7.6	81.889, 15.76, 4.75

Luminous Intensity (Cd) At Vertical Planes

Maximum Allowable Value: 2500 Cd

Calculations Tested (8):

Calculation Label	Test Results
ObtrusiveLight_Bld Perimeter_Cd_Seg1	**PASS**
ObtrusiveLight_Bld Perimeter_Cd_Seg2	**PASS**
ObtrusiveLight_Bld Perimeter_Cd_Seg3	**PASS**
ObtrusiveLight_Bld Perimeter_Cd_Seg4	**PASS**
ObtrusiveLight_Bld Perimeter_Cd_Seg5	**PASS**
ObtrusiveLight_Bld Perimeter_Cd_Seg6	**PASS**
ObtrusiveLight_Bld Perimeter_Cd_Seg7	**PASS**
ObtrusiveLight_Bld Perimeter_Cd_Seg8	**PASS**