

lighting will be appropriately screened from residential properties to ensure compliance with Part 13 of the Auckland Consolidated Bylaw.

3 Potential Adverse Lighting Effects

There are four lighting effects that can have varying degrees of importance to the residents adjacent to this installation; spill lighting, glare, skyglow and increased brightness of a building. The first three of these are primarily 'event-related' effects. The brightness of buildings and other surfaces is relevant for both event times as well as day-to-day use of the facilities at Eden Park. These effects are discussed in the following section.

3.1 Spill Lighting

If luminaires are not correctly chosen for the appropriate beamspread and properly aimed, there is a percentage of light that is not efficiently used to light its target. The result is wasted light 'spilling' into areas where it is potentially not wanted. Modern floodlights are computer designed and modelled to minimise the spill light.

3.2 Glare

Glare is the brightness of a floodlight when compared with the brightness of the background against which it is seen. For instance, a floodlight can look much brighter (and have higher glare) when viewed against a black background than when viewed in the surroundings of a brightly lit city street. There are two forms of glare; disabling glare and discomforting glare. Disabling glare is so intense it prevents adequate vision for accomplishing a task. Discomforting glare can generally be tolerated, but is more a nuisance, as it tends to draw the eye towards the light source.

3.3 Skyglow

Skyglow manifests itself as a glow above a stadium when humidity is high. This effect is difficult to mitigate, as it is the light that reflects off humidity and water particles in the air and also from the reflected component from a light-coloured target. Skyglow can be reduced by using darker coloured surfaces (i.e. dark coloured concrete rather than white) and with the use of floodlights having good optical control.

3.4 Brightness of Facades and Other Vertical Surfaces

This effect relates to the brightness of a façade against the surrounding environment. The brightness depends on the intensity of any of its internal light sources or the high reflective nature of any surfaces externally illuminated. For instance, a white façade lit by floodlights or windows lit from the interior will be more noticeable after dark, than a dark coloured façade or a windowless wall.

4 Light Level Requirements

4.1 International and New Zealand Standards

The Australian standard entitled "Control of the Obtrusive Effects of Outdoor Lighting" AS4282-1997 was written mainly to address the lighting for small recreational fields and carparks. This standard specifically excludes large stadia, which require special attention due to the prestige and higher lighting levels for international events generally requiring television broadcasting. However, some guidance for acceptable lighting levels for Eden Park can be derived from this document, particularly in relation to carparking areas, pedestrian concourses and the training area.

There are no New Zealand standards for the control of adverse lighting effects for large stadia. While there are local bylaw requirements for smaller installations, they are provided for simple safety and nuisance reasons.

4.2 District Plan Requirements

The Eden Park Concept Plan contained in Appendix B of the Operative City of Auckland – District Plan Isthmus Section provides for the use of artificial lighting associated with night-time use of the park producing an illuminance in excess of 150 lux as a discretionary activity. Otherwise, the District Plan generally defaults to Part 13 of the Auckland City Consolidated Bylaw which contains rules to limit the amount of light falling on land and buildings associated with residential use.

4.3 Existing Conditions of Consent

When the existing floodlighting was installed in 1995, a number of conditions of consent were imposed in relation to the floodlighting (resource consent LUC52960037301) including restrictions on the time and duration of use as well as the spill lighting and glare maxima. Relevant conditions are identified as follows:

- *Condition 14: The installed equipment shall not exceed a maximum spill light level of 25 lux when measured on the vertical plane at the window of any property not owned by the consent holder.*
- *Condition 15: The consent holder shall calculate the Threshold Increment (TI) as defined by NZ Standard 6701, or as AS 1158.1, and shall submit the same to the Council for review for the following locations:*
 - (a) *Travelling south over the rise toward Kowhai Intermediate School in Sandringham Road from New North Road at the intersection with Onslow Road.*
 - (b) *At the junction of Walters Road and Cricket Avenue at the upper section of Bellwood Avenue.*
 - (c) *Travelling west towards Cricket Avenue at the upper section of Bellwood Avenue.*
 - (d) *At the junction of Rossmay and Sandringham Road, looking east.*
 - (e) *At the junction of Altham and Sandringham Road, looking east.*
 - (f) *At the windows facing the stadium of residences at Numbers 4 and 6 Cricket Avenue.*

- (g) *At the windows facing the stadium of residences at Number 19, 27, 29, 31, 33, 35, 49, 54, 56, 58, 60, 62 and 64 Walters Road.*

[NB: Some of these monitoring locations are no longer relevant as the houses are either owned by EPTB and/or have since been demolished].

The Threshold Increment shall be 20% or less as calculated in NZ Standard 6701, or AS 1158.1. Where the TI is greater than 20%, screens, shields, or louvres approved by the Council shall be installed to reduce the TI to 20% or less. The details of the measures proposed to achieve compliance shall be submitted to the Council for approval before construction and shall comply with all relevant rules, bylaws and building requirements.

- *Condition 16: If a complaint regarding glare is received within seven days after the holding of any of the first three rugby and first three cricket night-time events taking place after the installation and operation of the lights and completion of the proposed north stand, from and residents living within a radius of 500 metres from the centre of the playing surface of the Eden Park No. 1 ground, a preliminary investigation shall be carried out by an independent registered lighting engineer appointed by the Council. If after this preliminary investigation the complaint is considered justified the Threshold Increment (TI) calculations, identified in NZ Standard 6701, or AS 1158.1, shall be provided by the consent holder and verified by the Council; and*
 - (a) *If the TI exceeds 20%, the matter giving rise to the complaint shall be remedied by the consent holder within 90 days, to the satisfaction of the Council.*
 - (b) *If the TI is less than 20% the complaint shall be deemed unjustified and no remedial action need be taken.*
- *Condition 17: The floodlights shall be switched to a level no higher than 300 lux 15 minutes after the finish of play and shall be turned off no later than 30 minutes after the finish of play.*

The upgrade of the floodlighting will generally still conform to these previous requirements. Proposed conditions of consent are set out in Attachment 1 and are discussed in Section 7 below.

5 Assessment of Lighting Effects

5.1 Spill Light

5.1.1 Modelling Parameters

The computer models the photometric characteristics of each of the floodlights as well as the 'blocking' effect of the stadium buildings. The output is in the form of 'isolux' lines that are similar to the familiar contour lines on geographical maps showing areas of equal height, but in this case, areas of equal lighting level.

The output of a preliminary computer model of the floodlighting following redevelopment with the proposed 2kW metal halide lamps is attached in Appendix A. This modelling has been undertaken based the lighting levels specified in Section 2.2 Table 1 above.

As discussed in Section 2.2, these lighting levels are consistent with other international venues in New Zealand. The results of modelling of floodlighting levels for the interim period during construction are also attached.

The computer modelling takes into account the general topography of the surrounding land, but does not include the effects of screening offered by vegetation, fences and surrounding houses, etc. It is therefore indicative of where effects may occur and presents more of a 'worst-case' scenario in that screening effects are not incorporated into the model.

5.1.2 Results of Modelling

The computer modelling (Drawing EK 03 attached in Appendix A) indicates that spill lighting from the new installation will generally comply with the existing conditions of resource consent (i.e. 25 lux measured at the window of any residential property not owned by EPTB).

On the north, south and east sides of the stadium, the sides where there are the most residential properties adjacent to the stadium, the spill light from the proposed lighting is considerably less than the existing installation. The key reasons for this are the increased height and therefore screening effect of the new South and East Stands, and the incorporation of the lights under the roof structure of the South Stand. Improved technology providing for more accurate focusing of the lighting from both the existing ASB towers and the proposed South Stand towers is also a factor in reducing light spill effects.

Due to the openings in the stadium at the northwest and southwest corners, and the lower western stand between these corners, spill lighting levels are higher at these locations following redevelopment. In the southwest corner, this spill light is contained on EPTB property and does not affect residential properties. To the north west of the stadium, the 25-isolux line crosses Sandringham Road at the position where the railway adjoins the road. This is predominantly non-residential land.

As noted above, this modelling is indicative and in many respects, represents a worst-case scenario. It is the intention of EPTB to work within the 25 lux limit set out in the existing conditions of consent, for all residential properties that are located outside of the Open

Space 5 zone and are not owned by EPTB. Detailed lighting design will focus on this design target.

5.2 Glare

Under existing resource consent conditions, glare is required to be calculated as a Threshold Increment (TI) percentage. This calculation is more applicable to road traffic than pedestrian/residential properties. For residential properties a more appropriate glare calculation is the Glare Rating (GR) as specified in CIE Document 112:1994. It is therefore proposed that glare calculations are calculated as TI for road locations as identified in the existing conditions of consent, and the Glare Rating (GR) is applied to residential properties identified in the existing conditions of consent.

The Chartered Institute of Building Services Engineers (CIBSE) sports lighting guide sets out a maximum glare rating of 50. This rating is specified more for players on the field, who are transitory. Players therefore do not suffer the same environmental effects as surrounding properties, where the lights may be shining onto their properties for extended periods of time.

A lower GR value of 40 is considered to be appropriate in the Eden Park context, and it is our recommendation that this value be the applicable limit at residential properties not owned by EPTB. We have reduced the GR in the proposed conditions from the CIBSE specified rating of 50, to 40, to account for the fact that the floodlights are likely to affect the residents in a different way than players.

Most of the positions for measurement of glare in the current resource consent conditions are now shaded from the effects of the lights by the new stadium, or are owned by EPTB. This includes the following properties or locations:

- The windows facing the stadium of residences at no's 4 & 6 Cricket Ave, and no's 19, 27, 29, 31, 33, 35 and 49 Walters Road are screened from the effects of the lights by the redevelopment.
- The junction of Walters Rd and Cricket Ave is also screened from the effects of the lights by the redevelopment.
- No's 54, 56, 58, 62 and 64 Walters Road are all owned by EPTB and have either been removed or are to be removed as part of this redevelopment.

As a result, TI calculations are required in the following locations:

- a) Travelling south over the rise toward Kowhai Intermediate School in Sandringham Road from New North Road at the intersection with Onslow Road.
- b) The upper section of Bellwood Avenue.
- c) At the junction of Rossmay and Sandringham Road, looking East.
- d) At the junction of Altham and Sandringham Road, looking East.

Where the TI is greater than 20%, glare from fittings will be reduced such that TI meets the required level of 20% or less.

GR calculations are required for No 60 Walters Road. It is noted however that EPTB either owns or plans to acquire those properties contained within the Open Space 5 zone in the

north western corner of the site making any such calculations redundant. Glare calculations are also recommended for the following additional locations:

We suggest that glare ratings are carried out for the following additional locations:

- At the windows of numbers 15 Sandringham Rd, 69 Sandringham Rd, 19 Royal Terrace, and 11 Bellwood Avenue.

These properties were selected as they are typical of properties somewhat further away from the shading effects of the stadium. GR calculations for these properties are attached in appendix H.

5.3 Skyglow

Skyglow is dependent on weather conditions, in particular high humidity. Floodlights with a tight beam distribution do assist in the reduction of skyglow. This has been addressed in the preliminary selection of modern luminaires, which provide good control of light while still permitting further refinement of the design for spill light levels in detailed design. It is also noted that the occurrence of skyglow is limited to night-time events in certain weather conditions. The effects are therefore limited and it is not anticipated that there will be any change in effects associated with the proposed redevelopment.

5.4 Pedestrian Areas and Carparks

The current standard in New Zealand for the provision of adequate lighting for pedestrian pathways is the pedestrian Section of AS/NZS 1158.3.1:2005 "Lighting for Roads & Public Spaces, Part 3.1: Pedestrian Area (Category P) Lighting – Performance and Design Requirements". This gives illuminance and uniformity levels for exterior walkways and carparks. Also applicable is the CPTED Guidelines Crime Prevention through Environmental Design (City Design 2001). Auckland City has also implemented raised lighting levels based on AS/NZS 1158.3.1:2005, outlined in the Auckland City Public Lighting Study: 2003. These illuminance levels have been applied as set out in Table 3 below.

Table 3: Illuminance levels for pedestrian and car parking areas

Description of area	Lighting Cat.	Pedestrian Activity	Risk of Crime	Need to Enhance Prestige	Min. Ave Illum. Levels (lux)	Min. Illum Level (lux)	Maximum Uniformity
Pedestrian walkways, exterior concourses etc	P2	High	Medium	High	3.5	0.7	6
Carparks, aisles, and the circulation roadways.	P11a	High	Medium	N/A	14	3	10

The lighting installed for the pedestrian and amenity lighting will comply with the requirements of these documents.