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# SYDNEY TRAINS BILLBOARDS

***Site 3: Sussex Street, Sydney CBD***

# EVALUATION OF LIGHTING IMPACT

Prepared by:

**Lighting, Art and Science**

for

**Ethos Urban**

**Table of Contents**

# 1. INTRODUCTION

Lighting Art & Science has been engaged to assess the light obtrusion of proposed new LED billboard signs at the pedestrian footbridge on Sussex Street, Sydney CBD. The proposed signs are bridge mounted on existing pedestrian footbridge of Exchange Lane above Sussex Street.

The proposed signs will be digital LED signs with variable content.

# 2. RELEVANT STANDARDS

There are several standards that may have relevance to this site.

- AS/NZS4282: *Control of obtrusive effects of outdoor lighting*, gives control for the levels of spill light that can be reasonably expected in an urban environment. This is not called up in any NSW legislation, however conformance is commonly required in LEPs (Local Environmental Plans). The standards main concentration is on the impact on residents although it also considers the impact on drivers and the environment.
- 
- NSW Transport Corridor Advertising and Signage Guidelines (NSWTAG) specifies luminance limits on signs by day and night. It concentrates on the impact on traffic.
- CASA Manual of Standards Part 139-Aerodromes- section 9.21 (CASA MoS Pt 139)

Both AS/NZS4282 and NSWTAG include limits on the graphical content including dwell time, change in luminance between images and colour; however, these are outside the scope of this study.

# 3. AS/NZS4282

*AS4282 Control of the obtrusive effect of outdoor lighting was* written to establish limits of light obtrusion that provide a reasonable balance between impact of light on the amenity of the neighbour and the ability to have an external lighting installation.

This standard is only applicable to night-time hours.

The preface of the standard states “These criteria have been employed to ensure that the standard is both *credible* to the interested parties and *pragmatic* in application.”

The standard recommends limits for several light technical parameters (LTP) based on the ambient conditions (Environmental Zones), and time of night (Non-curfew and Curfew Period).

## 3.1 Environmental Zone

The higher the ambient conditions, the higher the allowable obtrusive lighting limit.

Table 3.1 is an extract from the standards detailing the various environmental zones.

The environmental zones relate to the nature of the surrounding areas and represent not only the expected ambient lighting but also the level of activity.

TABLE 3.1

ENVIRONMENTAL ZONES

| Zones | Description | Examples |
|---|---|---|
| A0 | Intrinsically dark | UNESCO Starlight Reserve. IDA Dark Sky Parks.<br>Major optical observatories<br>No road lighting -unless specifically required by the road controlling authority |
| A1 | Dark | Relatively uninhabited rural areas<br>No road lighting - unless specifically required by the road controlling authority |
| A2 | Low district brightness | Sparsely inhabited rural and semi-rural areas |
| A3 | Medium district brightness | Suburban areas in towns and cities |
| A4 | High district brightness | Town and city centres and other commercial areas<br>Residential areas abutting commercial areas |
| TV | High district brightness | Vicinity of major sports stadium during TV broadcasts |
| V | Residences near traffic routes | Refer AS/NZS1158.1.1 |
| R1 | Residences near local roads with significant setback | Refer AS/NZS 1158.3.1 |
| R2 | Residences near local roads | Refer AS/NZS 1158.3.1 |
| R3 | Residences near a roundabout or local area traffic management device | Refer AS/NZS 1158.3.1 |
| RX | Residences near a pedestrian crossing | Refer AS/NZS 1158.4 |

NOTE: Recreational areas are not considered commercial.

*Table 3.1: Environmental Zones AS/NZS4282:2019 (table 3.1)*

### 3.2 Curfew period

The standard includes a curfew period during which the light technical parameters are significantly reduced. It is assumed that during these periods the majority of residential activity will have ceased, and people will be sleeping.

The stricter curfew limits only apply to the windows of 'habitable' rooms defined in the standard as; "A room within a dwelling that is occupied by people for extended periods, especially at night, e.g. living room, bedroom and study but not bathroom, kitchens or storage room."

The default time for the curfew period is 11:00pm to 6:00am; however, the consent authority can amend the times.

### 3.3 Light technical parameters (LTPs)

AS/NZS4282 applies limits to five light technical parameters.

Conformance with the standard is by calculation rather than measurement. This enables approval prior to the installation of the lighting separate from the contribution of existing lighting.

The light technical parameters are as follows:

#### 3.3.1 Illuminance in the vertical plane

This is a measure of the general light spill onto the property. The levels are calculated at the face of the building/regulatory building line in the vertical plane and facing perpendicular to the fence, or building.

The illuminance in the vertical plane is an assessment of the extent to which the lighting will light up the interior of a residence facing the installation.

For a small light source the Illuminance reduces proportionally to the square of distance from the light source. As a result, the further away from the light source the less the impact. The illuminance also reduces as the angle from the perpendicular increases.

Where the area of the light source is large with respect to the distance from the light source the illuminance is less effected by distance.

The ***illuminance*** is a measure of the amount of light falling on a surface and is measured in ***lux.***

The illuminance used in AS/NZS4282 is the direct illuminance resulting from the installation; that is the light that comes directly from the light fittings.

In all installations there is also indirect light that is reflected off the ground, walls of buildings, objects in the lit area and in some cases reflections from clouds and the sky.

The standard only addresses direct illumination effects. This is due to the standard being designed to determine conformance or non-conformance. Direct illumination can be readily and reliably calculated. Indirect illumination is a result of light reflected off the ground and other surfaces and will change depending on things like, the colour of buildings, the colour of clothes people are wearing, whether trees have leaves etc. and whether the surfaces are wet or dry.

The standard only looks at the illuminance resulting from the proposed installation and not the cumulative impact of the other lighting in an area (e.g. nearby street lighting etc.).

### 3.3.2 Luminous Intensity emitted by luminaires

This is a measure of the brightness of the light source in a given direction and is used by the standard as an approximation of the glare generated.

This is governed by the brightness of the light source, the glare control of the light fitting and the viewing angle. This affect does not reduce with distance; however, with a very small light source the perception will reduce as the image of the light on the eye becomes smaller than the size of the light receptors in the eye. In addition, if the distance is long enough there will be a reduction in the brightness due to the permeability of the air.

It is used in this standard as an indication of the level of distraction or discomfort the lighting might cause. The luminous intensity relates to a specific direction and will depend on the light distribution of the light fitting and the direction of view.

***Luminous Intensity*** is the light leaving a source in a given direction and is measured in ***candelas***.

As the luminous intensity varies with the area of the light source, the correlation between the luminous intensity and glare only works for physically small light sources. As a result, it is not used for the assessment of signage or large area sources.

### 3.3.3 Luminance

The **Luminance** is the light that leaves the area of a surface in all directions. It is measured in ***candela/m$^2$***. The eye sees images by distinguishing the difference in luminance between the different objects and surfaces.

Luminance is a better indication of the obtrusive effects of large area sources such as signs or floodlit facades.

### 3.3.4 Threshold Increment

This is a measure of the disability glare that results from the light sources and their impact on driver's ability to read signs, signals and see objects. The threshold increment is calculated from the driving position for cars driving on roads that are near the lighting installation. AS/NZS4282 assumes a background luminance based on the Environmental Zone.

### 3.3.5 Upward Light Ratio (ULR)

Upward Light Ratio is the ratio of the light that is emitted from the luminaires, in their aimed positions, divided by the total light emitted by the luminaires. This is a measure of the contribution of the installation to sky glow.

AS/NZS4282 has a standard limit or ULR for internally lit signs of 50%.

### 3.3.6 Relevant Light Technical Parameters

The relevant Light Technical Parameter limits from AS/NZS4282 are indicated in Tables 3.2 and 3.3.

**Maximum Values of Light Technical Parameters**

| Zones | Vertical illuminance levels ($E_v$) lx | | Threshold Increment (*TI*) | |
|---|---|---|---|---|
| | Non-Curfew | Curfew | % | Default adaptation level ($L_{ad}$) |
| A2 | 5 | 1 | 20% | 0.2 |
| A3 | 10 | 2 | 20% | 1 |
| A4 | 25 | 5 | 20% | 5 |

*Table 3.2 Excerpt from table 3.2 of AS/NZS4282*

**Maximum Average Luminance of Surfaces (cd.m$^2$)**

| Environmental Zones | | | | |
|---|---|---|---|---|
| A0 | A1 | A2 | A3 | A4 |
| 0.1 | 0.1 | 150 | 250 | 350 |

*Table 3.3 Excerpt from table 3.5 of AS/NZS4282*

The complete tables from AS/NZS4282 are included as Annexure A

## 4. NSW TRANSPORT CORRIDOR ADVERTISING AND SIGNAGE GUIDELINES

The NSW Transport Corridor Advertising and Signage Guidelines have specific criteria for digital signs in Section 2.5.8 Digital signs. These relate to motion in the content, the dwell time of the content and the transition time to minimise distraction to drivers. These criteria are principally associated with the sign digital content and are outside the scope of this analysis.

Table 6 in the Guidelines sets luminance limits for the day and night operation of digital signs.

| Lighting Condition | Zone 1 (cd/m$^2$) | Zones 2 and 3 (cd/m$^2$) | Zone 4 (cd/m$^2$) |
|---|---|---|---|
| Full sun on face of signage | No limit | No limit | No limit |
| Daylight luminance | | 6000 | 6000 |
| Morning and evening twilight and inclement weather | 700 | 700 | 500 |
| Night-time | 350 | 350 | 200 |

*Table 4.1 Copy of Table 6 from NSW Transport Corridor Advertising and Signage Guidelines*

The zones referred to in the table are different to the Environmental Zones in AS/NZS4282 and are defined as follows:
**"Zone 1** covers areas with generally very high off-street ambient lighting, e.g. display centres similar to Kings Cross in Sydney, and Central Business District locations. This would normally be expected to include land zoned B8 Metropolitan Centre and may include land zoned B3 Commercial Core or B4 Mixed Use, but does not exclude other land use zones.

**Zone 2** covers areas with generally high off-street ambient lighting e.g. some major shopping/commercial centres with a significant number of off-street illuminated advertising devices and lights. This could be expected to include land zoned B3 Commercial Core or B4 Mixed Use, but does not exclude other land use zones.

**Zone 3** covers areas with generally medium off-street ambient lighting e.g. small to medium shopping/commercial centres. This would normally be expected to include land zoned B1 Neighbourhood Centre and B2 Local Centre, but does not exclude other land use zones.

**Zone 4** covers areas with generally low levels of off-street ambient lighting e.g. most rural areas, or areas that have residential properties nearby. This would normally be expected to include most RU Rural land use zones apart from the RU5 Village zone, but does not exclude other land use zones."

## 5. CASA Manual of Standards Part 139-Aerodromes- section 9.21

The CASA (Civil Aviation Safety Authority) Standard relates to the potential confusion for pilots landing at a local aerodrome. This only relates to lights within specific corridors around the approach to the runways.

The zone of control for CASA is shown in Annexure B.

## 6. PROPOSED SIGNAGE

The location of site is shown below.


*Figure 6.1 – Sussex Street, Sydney CBD*

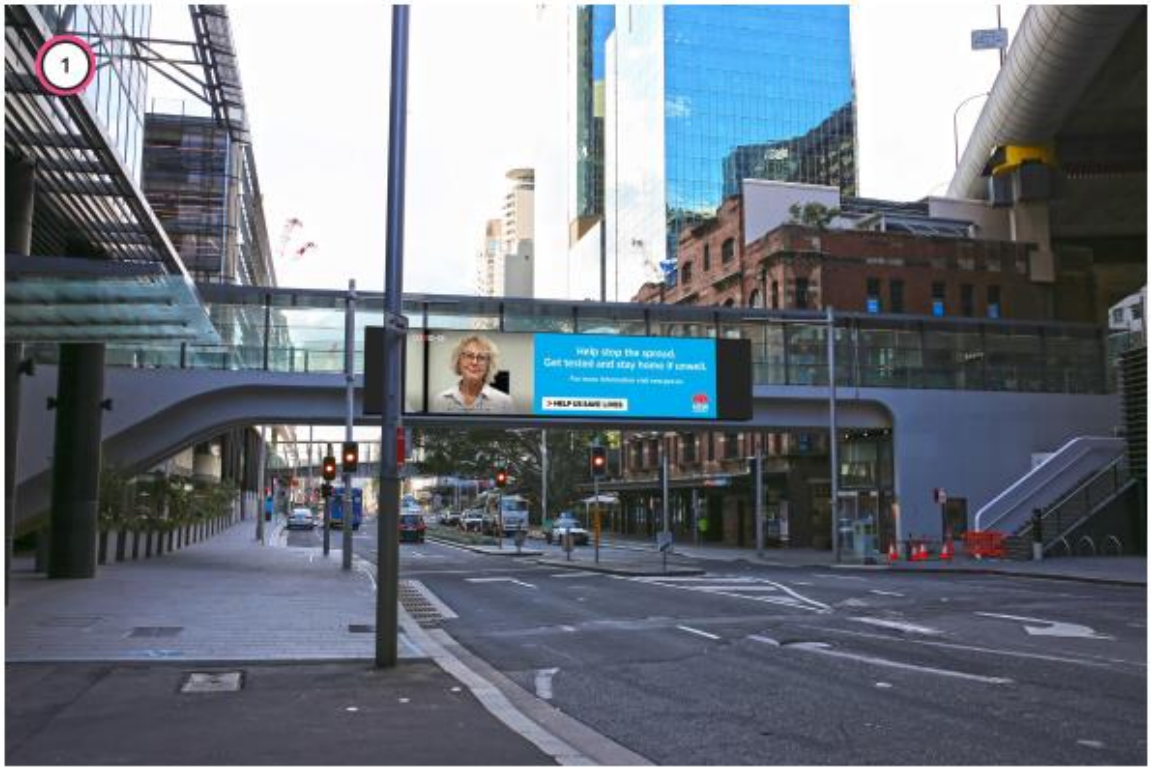


*Figure 6.2 –Elevation Sign 1*


*Figure 6.3 –Elevation Sign 2*

The sign is predominantly surrounded by commercial properties. There were no residences identified to have a direct view of the proposed signs.

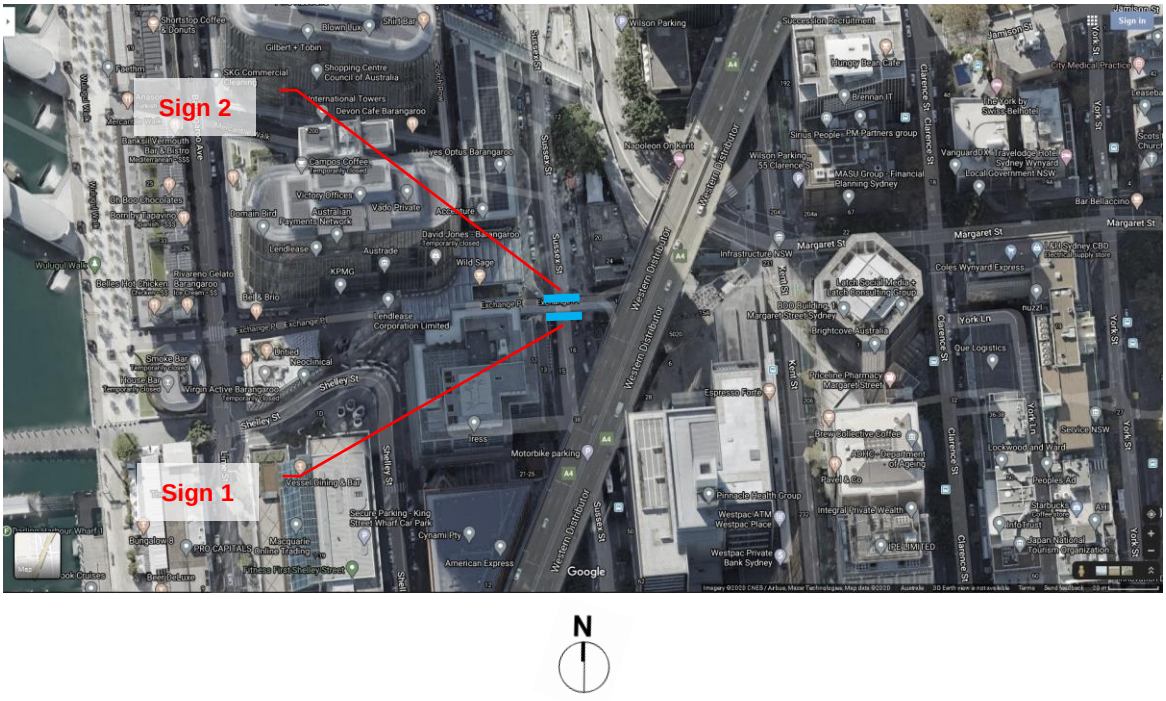


*Figure 6.4 – Plan showing sign surrounds*

## 7. PARAMETERS

The proposed signs will be a LED sign with variable image content.
There has not been a sign supplier appointed at this stage, so we have based the design on generic sign elements.
We have assessed the signs using a Lambertian source to represent a sign module.
The Lambertian model has a slightly wider distribution than the typical sign and therefore is a conservative estimate of the impact on surrounding residences.
The signs have a variable light output to optimise visibility by day and night.

The proposed sign will have the following physical parameters:

| Parameter | Value | Comment |
|---|---|---|
| Overall Height | 3.3m<br>(3.2m visual screen width) | |
| Overall Width | 15.5m<br>(12.4m visual screen width) | |
| Module Height | 365.76mm Nominal | Refer Note 1 |
| Module Width | 365.76mm Nominal | |
| Number of Modules | 306 (34 across x 9 high) | Refer Note 1 |
| Maximum Daylight Luminance | 6000 Cd/$m^2$ | Refer Note 2 |

*Note 1: The size and therefore the number of modules can vary from brand to brand of sign technology.*
*Note 2: The Maximum Luminance shall be set to 6000 Cd/$m^2$.*

***Table 7.1 Physical Parameters***

Based on the location of the sign we believe that the applicable environmental limits/zones and LTPs will be as follows:

| | |
|---|---|
| Environmental Zone to AS/NZS 4282 | Zone A4 |
| NSW Transport Corridor Advertising and Signage Guidelines | Zone 2 |
| Maximum Vertical Illuminance – Non-Curfew | 25 lx |
| Maximum Vertical Illuminance – Curfew | 5 lx |
| Maximum Threshold Increment | 20% @ $L_{ad}$ =5 |
| Maximum average Luminance of Surface | 350 cd |
| Upward Light Output Ratio | 50% |

***Table 7.2 Applicable limits***

## 8. METHODOLOGY

A site inspection was undertaken on 21 July 2020 to identify residential dwellings surrounding the site and to identify any permanent obstructions to the view of the sign.

The luminance of the sign was taken from the typical technical information for the sign modules.

The specification of the Daktronics DVX-1801-10MN-6000-WN has been included in Annexure C as a typical example of the sign technology and performance.

As the signs have a variable output the night-time luminance can be varied to meet the limits in AS/NZS4282 and the NSW Transport Guidelines.

The sign and the surroundings were modelled using AGI32 an industry standard lighting modelling software with a specific module to calculate obtrusive light to AS/NZS4282.

The Light Technical Parameters were calculated at the night-time average luminance limit in AS/NZS4282 and the NSW Transport Guidelines for the appropriate environmental zones.

The average luminance of the sign was reduced to achieve conformance with the Luminance, Vertical Illuminance and Threshold Increment, whichever parameter was critical to conformance for the Environmental Zone. This then sets the maximum average luminance that could be used at night-time.

This model generated a compliance statement relating to the threshold increment and the vertical illuminance. The report and prints of the model are included in Annexure D.

The vertical illuminance is the only relevant LTP that has a different curfew limit. As there are no residences in close proximity to the signs, we have not prepared a separate curfew report.

## 9. CONFORMANCE

Table 9.1 summarises the results of the assessment and the level of conformance.

| Light Technical Parameter | Required Limit | Calculated Result | Dimming level | Conformance |
|---|---|---|---|---|
| NSWTAG Morning and evening twilight and inclement weather | 6000 cd/m$^2$ | Level set to comply | 100% or dimmed to 6000cd/m$^2$ (Reference Level) | YES |
| NSWTAG Morning and Evening Twilight Luminance | 700 cd/m$^2$ | Level set to comply | 12% of Reference Level | YES |
| NSWTAG Night-time Luminance | 350 cd/m$^2$ | Level set to comply | 6% of Reference Level | YES |
| Maximum Average Luminance as per AS/NZS 4282 table 3.5 Non-Curfew L1 | 350 cd/m$^2$ | Level set to comply with the threshold increment | 282 cd/m$^2$ 4.7% of Reference Level | YES |
| Maximum Average Luminance Curfew | 350 cd/m$^2$ | Level set to comply with the threshold increment | 282 cd/m$^2$ 4.7% of Reference Level | YES |
| Maximum Vertical illuminance Non-Curfew L1 | N/A, no nearby residences identified | N/A | N/A | N/A |
| Maximum Vertical illuminance Curfew | N/A, no nearby residences identified | N/A | N/A | N/A |
| Maximum Threshold Increment Result Non-Curfew L1 (Annexure C) | 20% @ $L_{ad}$ =5 | Level set to comply with the threshold increment | 20% 4.7% of Reference Level | YES |
| Maximum Threshold Increment Result Curfew (Annexure C) | 20% @ $L_{ad}$ =5 | Level set to comply with the threshold increment | 20% 4.7% of Reference Level | YES |
| CASA MoS Pt 139 | Not Applicable in this location | N/A | N/A | N/A |
| Upward Waste Light Ratio | 50% | | 49.2% | YES |

*Table 9-1: Summary conformance*

## 10. CONCLUSION

The proposed signage is fully compliant with the lighting limits of:

- AS/NZS4282: *Control of obtrusive effects of outdoor lighting*,
- NSW Transport Corridor Advertising and Signage Guidelines (NSWTAG)
- CASA Manual of Standards Part 139-Aerodromes- section 9.21 (CASA MoS Pt 139)

Subject to the dimming levels nominated in table 9.1.

## 11. REFERENCES:


a) AS/NZS4282:2019
b) NSW Transport Corridor Advertising and Signage Guidelines
c) CASA Manual of Standards Part 139-Aerodromes- section 9.21
d) Daktronics Product Specification DVX-1801-10MN-6000-WN (Typical Example)

## 12. ANNEXURE A – Relevant tables from AS/NZS4282

**TABLE 3.2**

**MAXIMUM VALUES OF LIGHT TECHNICAL PARAMETERS**

| Zones | Vertical illuminance levels ($E_v$) lx | | Threshold increment ($TI$) | | Sky glow |
|---|---|---|---|---|---|
| | Non-curfew | Curfew | % | Default adaptation level ($L_{ad}$) | Upward light ratio |
| A0 | See Note 1 | 0 | N/A | N/A | 0 |
| A1 | 2 | 0.1 | N/A | N/A | 0 |
| A2 | 5 | 1 | 20% | 0.2 | 0.01 |
| A3 | 10 | 2 | 20% | 1 | 0.02 |
| A4 | 25 | 5 | 20% | 5 | 0.03 |
| TV | See Table 3.4 | N/A | 20% | 10 | 0.08 |
| V | N/A | 4 | Note 2 | Note 2 | Note 2 |
| R1 | N/A | 1 | 20% | 0.1 | Note 3 |
| R2 | N/A | 2 | 20% | 0.1 | Note 3 |
| R3 | N/A | 4 | 20% | 0.1 | Note 3 |
| RX | N/A | 4 | 20% | 5 | Note 4 |

NOTES:

1 For A0, $E_v$ shall be as close to zero as practicable without impacting safety considerations.

2 Refer to AS/NZS 1158.1.1.

3 Refer to AS/NZS 1158.3.1.

4 Refer to AS/NZS 1158.4.

5 N/A means 'Not Applicable'.

6 For an internally illuminated sign in an A2 zone, $L_{ad} \leq 0.25$ cd/m$^2$.

**TABLE 3.5**

**MAXIMUM AVERAGE LUMINANCE OF SURFACES (cd/m$^2$)**

| Application conditions | Environmental zones | | | | |
|---|---|---|---|---|---|
| | A0 | A1 | A2 | A3 | A4 |
| See Clause 3.3.5.4 | 0.1 | 0.1 | 150 | 250 | 350 |

# 13. ANNEXURE B – CASA Control Area



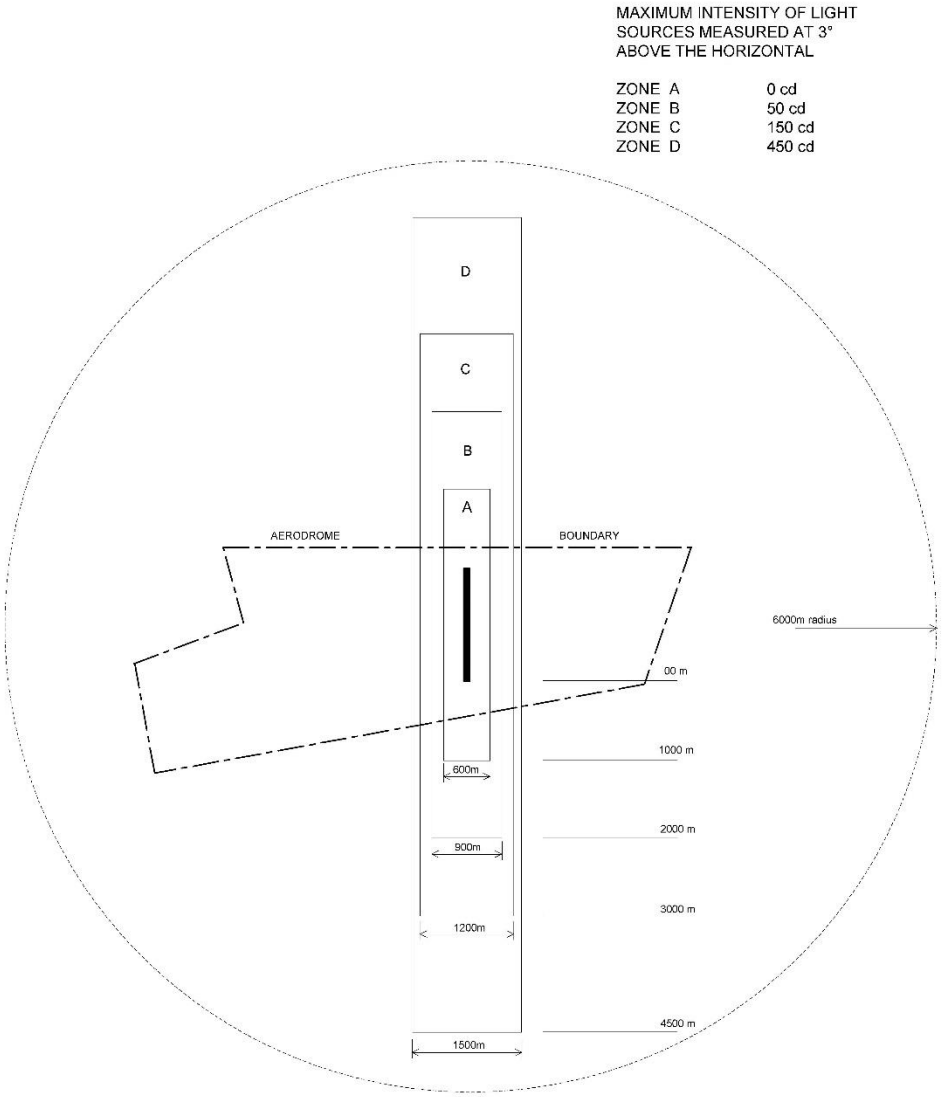


**Figure 9.21-1: Maximum lighting intensities**

## 14. ANNEXURE C – Typical Sign Modules

# DAKTRONICS PRODUCT SPECIFICATION

## SERIES SPECIFICATION

### DVX-1801-10MN-6000-WN

| | |
|---|---|
| **Pixel Configuration** | RGB 3-in-1 SMD |
| **Line and Column Spacing** | 0.4 inches - 10.16 millimeters |
| **Module Configuration - Pixels (RxC)** | 36 x 36 pixels |
| **Module Dimensions (HxW)** | 14.4 x 14.4 inches - 365.76 x 365.76 mm |
| **Maximum Power per Module[1]** | 76.0752 Watts |
| **Average Power per Module[1]** | 20 Watts |
| **Display Weight per Module[2]** | 15.9 pounds - 7.21 kilograms |
| **Processing** | 22 bit Distributed |
| **Color Capacity** | 16 bit (281 Trillion Colors) |
| **Dimming** | 256 levels |
| **Color Temperature** | 3,000°-10,000° kelvin (adjustable) |
| **Calibration** | Full depth, LED to LED |
| **LED Refresh Rate** | 4800 hertz |
| **LED Lifetime** | 100,000 hrs |
| **Brightness - Typical Nits** | 6000 nits (cd/sm) |
| **Horizontal Viewing Angle** | 160° |
| **Vertical Viewing Angle (Up/Down)** | +25/-45° |
| **Contrast Ratio** | 1200:1 |
| **Service Access** | Front or Rear |
| **Cabinet Depth** | 8.716 inches - 221.38 millimeters |
| **Cabinet Construction** | Steel and Aluminum (corrosion resistant) |
| **Ingress Protection Rating** | IP-66 Rated Components |
| **Working Temperature Rating[3]** | -40° to 113° F - -40° to 45° C |
| **Ventilation** | Fan, Internal Deflector, Vent Panel |
| **Data Transmission to Display** | Direct: Fiberoptic Cable Remote: Internet/Network (IP) |

Note 1: Power draw varies depending on display ventilation.

Note 2: Display Weight per Module factors in cabinet, but not the structure.

Note 3: Temperature range is based on typical usage (100% daytime brightness, 50% content, 250W/m2 solar, no wind).

Note 4: Ventilation solution may require external supplemental A/C in some areas of the world. Please consult your Daktronics representative regarding your area.

Note 5: Consistent with Daktronics policy of continuing product improvement, specifications shown on this document are subject to change without notice.

## DISPLAY SPECIFICATION

### DVX-1801-10MN-6000-WN-HC-468X828-120v-MT-MR-CNTLRM

| | |
|---|---|
| **Active Screen Size (HxW)** | 15.6 feet x 27.6 feet - 4.75 meters x 8.41 meters |
| **Active Screen Size (Square Dimensions)** | 430.56 square feet - 39.95 square meters |
| **Number of Modules (HxW)** | 13 Modules x 23 Modules |
| **Total Modules** | 299 Modules |
| **Matrix Size (HxW)** | 468 pixels x 828 pixels |
| **Aspect Ratio** | 0.5652 (Reference - 16:9 = .5625 and 4:3 = .75) |
| **Display Weight** | 4754.1 lb - 2155.79 kg |
| **Display Weight per Square Dimension** | 12 lb/sq. ft - 54 kg/sq. m |
| **Total Average Power Consumed** | 5980 Watts |
| **Total Maximum Power Consumed** | 22747 Watts |
| **Maximum Power Consumption per Square Dimension** | 52.8 W/sq. ft - 569.4W/sq. m |
| **Current Draw** | 103.4 amps @ 220v 1P - 33 amps @ 380/415v 3P - 94.8 amps @ 120/240v - 63.2 amps @ 208Y/120v 3P |
| **Control Method** | Rack Mount Control System |

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DAKTRONICS


**01** **PLAN VIEW**

1:500@A1

# SITE 3
# SUSSEX STREET, SYDNEY CBD
# Obtrusive Lighting Compliance
# Non-Curfew L1 & Curfew

**Scope**

The scope of the works for the installation of new billboard signage on both sides of the pedestrian footbridge located at Exchange Place on Sussex Street, Sydney CBD, is to comply with the requirements of AS/NZS 4282:2019, Category A4.

| **Category** | **A4** |
|---|---|
| Vertical Illuminance Non-Curfew L1 | <25 lux |
| Vertical Illuminance Curfew | <5 lux |
| Threshold Increment | <20% |
| Threshold Increment adaptation level | 5 |
| Upward Waste Light Ratio | <50% |

| **Scene Summary** | | | | |
|---|---|---|---|---|
| **Scene: BOTH SIGNS - 4.7%** | | | | |
| **Channel** | **Label** | **Switched** | **Dimming** | **Height to bottom of sign** |
| Sign 1 | SIGN | On | 0.047 | 5.5m |
| Sign 2 | SIGN | On | 0.047 | 5.5m |

| **Calculation Summary** | | | | | |
|---|---|---|---|---|---|
| **Scene: BOTH SIGNS - 4.7%** | | | | | |
| **Description** | **CalcType** | **Units** | **Max** | **PtSpcLr** | **PtSpcTb** |
| ObtrusiveLight_TI_A4 - BL - SBL | Obtrusive Light - TI | % | 11 | 5 | 0 |
| ObtrusiveLight_TI_A4 - SSt - NB - L1 | Obtrusive Light - TI | % | 16 | 5 | 0 |
| ObtrusiveLight_TI_A4 - SSt - NB - L2 | Obtrusive Light - TI | % | 20 | 5 | 0 |
| ObtrusiveLight_TI_A4 - SSt - SB - L1 | Obtrusive Light - TI | % | 15 | 5 | 0 |
| ObtrusiveLight_TI_A4 - SSt - SB - L2 | Obtrusive Light - TI | % | 20 | 5 | 0 |

| **UWLR Area Summary** | |
|---|---|
| **Project: ULR Signage** | |
| **Scene: BOTH SIGNS - 4.7%** | |
| **Label** | **UWLR** |
| ULR Sign 1 | 0.492 |
| ULR Sign 2 | 0.492 |

| **Luminaire Schedule** | | |
|---|---|---|
| **Scene: BOTH SIGNS - 4.7%** | | |
| **Label** | **Dimming** | **Luminance at dimming level** |
| SIGN | 0.047 | 282 cd/m² |

Vertical illuminance limits are only applicable to "A room within a dwelling that is occupied by people for extended periods, especially at night, e.g. living room, bedroom and study, but not bathroom, kitchens or storage room."
There are no habitable rooms in the vicinity of the billboard signage, and vertical illuminance calculations are not required.

## Obtrusive Light - Compliance Report

AS/NZS 4282:2019, A4 - High District Brightness, Non-Curfew L1
Filename: L164K-CL03-Site 3 - Sussex St
30/07/2020 4:07:10 PM

### Threshold Increment (TI)

Maximum Allowable Value: 20 %

Calculations Tested (5):

| Calculation Label | Adaptation Luminance | Test Results |
|---|---|---|
| ObtrusiveLight_TI_A4 - BL - SBL | 5 | PASS |
| ObtrusiveLight_TI_A4 - SSt - SL1 | 5 | PASS |
| ObtrusiveLight_TI_A4 - SSt - SL2 | 5 | PASS |
| ObtrusiveLight_TI_A4 - SSt - NL2 | 5 | PASS |
| ObtrusiveLight_TI_A4 - SSt - NL1 | 5 | PASS |

## Obtrusive Light - Compliance Report

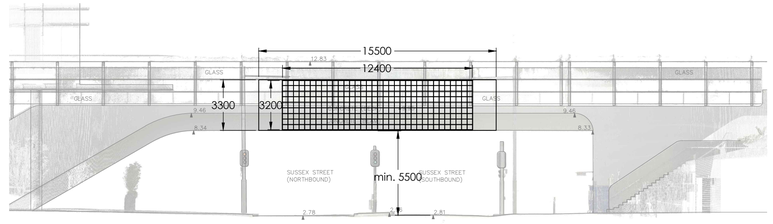
AS/NZS 4282:2019, A4 - High District Brightness, Curfew
Filename: L164K-CL03-Site 3 - Sussex St
30/07/2020 4:07:21 PM

### Threshold Increment (TI)

Maximum Allowable Value: 20 %

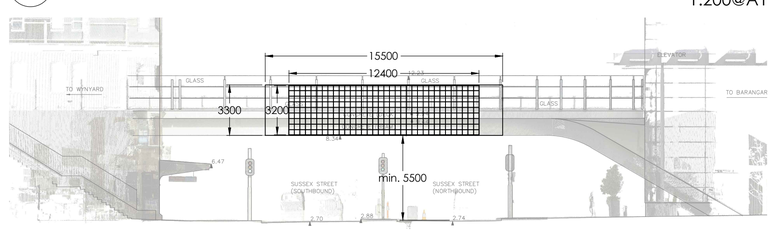
Calculations Tested (5):

| Calculation Label | Adaptation Luminance | Test Results |
|---|---|---|
| ObtrusiveLight_TI_A4 - BL - SBL | 5 | PASS |
| ObtrusiveLight_TI_A4 - SSt - SL1 | 5 | PASS |
| ObtrusiveLight_TI_A4 - SSt - SL2 | 5 | PASS |
| ObtrusiveLight_TI_A4 - SSt - NL2 | 5 | PASS |
| ObtrusiveLight_TI_A4 - SSt - NL1 | 5 | PASS |




**02** **INDICATIVE ELEVATION VIEW - SIGN 1**

1:200@A1




**03** **INDICATIVE ELEVATION VIEW - SIGN 2**

1:200@A1

| Issue | Amendment | Date |
|---|---|---|
| P1 | PRELIMINARY ISSUE | 31-07-20 |

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AS SHOWN

Notes:
1. Final location of sign to be confirmed.
2. Height of Threshold Increment points: 1.5m.
3. Calculations based on Lambertian source of 365.76mm x 365.76mm. Visual screen size: 12.4m x 3.2m. Number of modules: 306 (34 across, 9 high).

Lead Consultant
ETHOS URBAN

Client
SYDNEY TRAINS

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Project SYDNEY TRAINS BILLBOARDS

Drawing SITE 3 - SUSSEX STREET
CALCULATIONS - A4 - NON-CURFEW & CURFEW

| Drawn | Approv. | Date | Scale |
|---|---|---|---|
| | | JUL 2020 | AS SHOWN |

| Project No | Drawing No | Rev |
|---|---|---|
| L164K | CL03 | P1 |

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