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SYDNEY TRAINS BILLBOARDS

Site 17: Granville, Woodville Road

EVALUATION OF LIGHTING IMPACT

Prepared by:

Lighting, Art and Science

for

Ethos Urban

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1. INTRODUCTION

Lighting Art & Science has been engaged to assess the light obtrusion of proposed new LED billboard signs at Woodville Road, Granville. The proposed signs are bridge mounted on the existing railway overpass above Woodville Road.

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.
- NSW Transport Corridor Advertising and Signage Guidelines (NSWTAG) specifies luminance limits on signs by day and night concentrating 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. Major optical observatories No road lighting -unless specifically required by the road controlling authority
A1	Dark	Relatively uninhabited rural areas 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 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.

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.

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.

Although inter-reflected light does have an effect, it cannot be reliably calculated and therefore cannot be a criteria for conformance.

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 the relationship with 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 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.

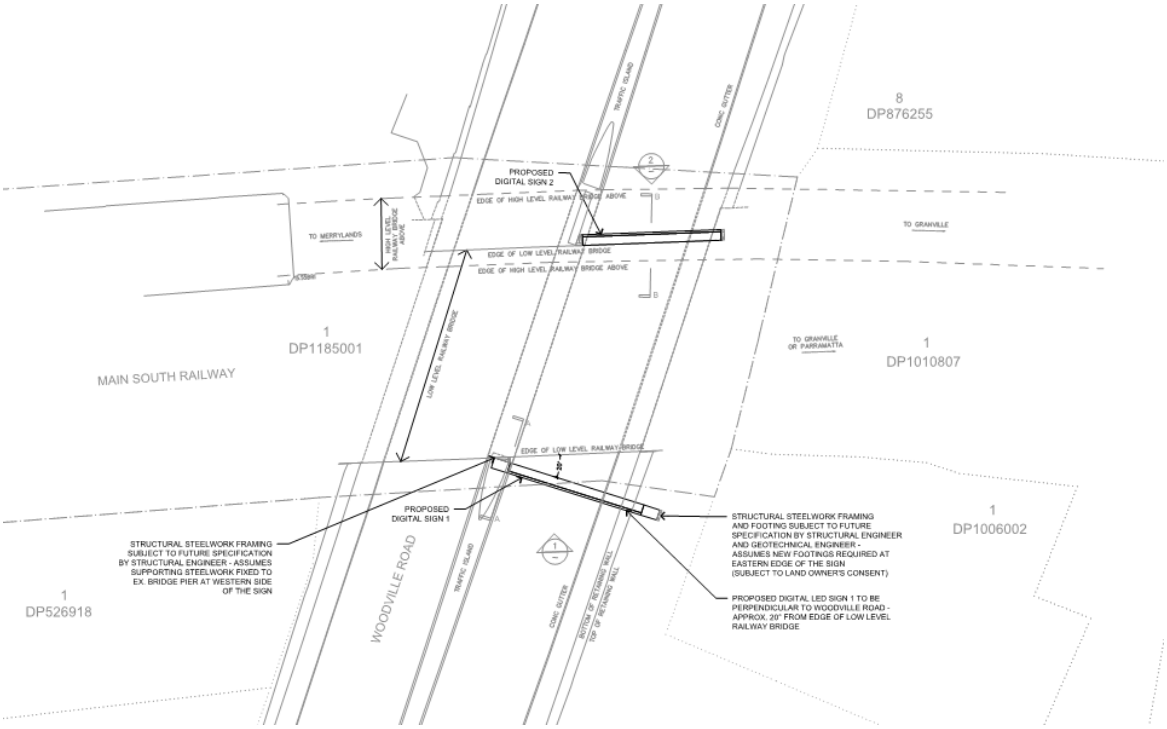


Figure 6.1 – Woodville Road, Granville

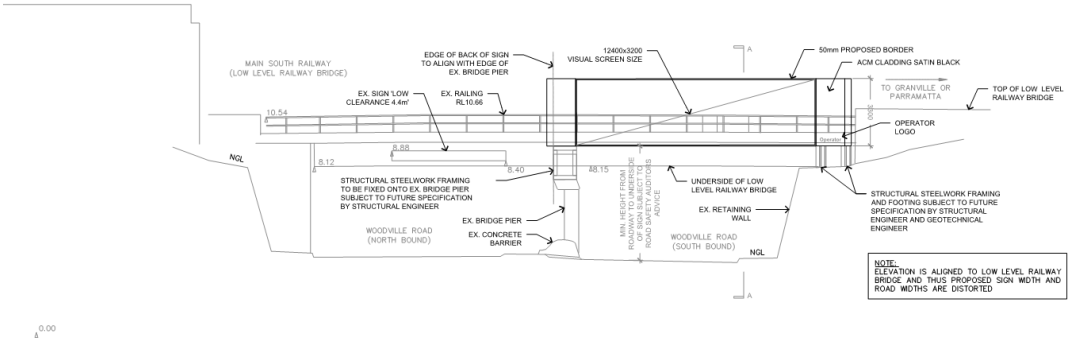


Figure 6.2 –Elevation sign 1 (south elevation)

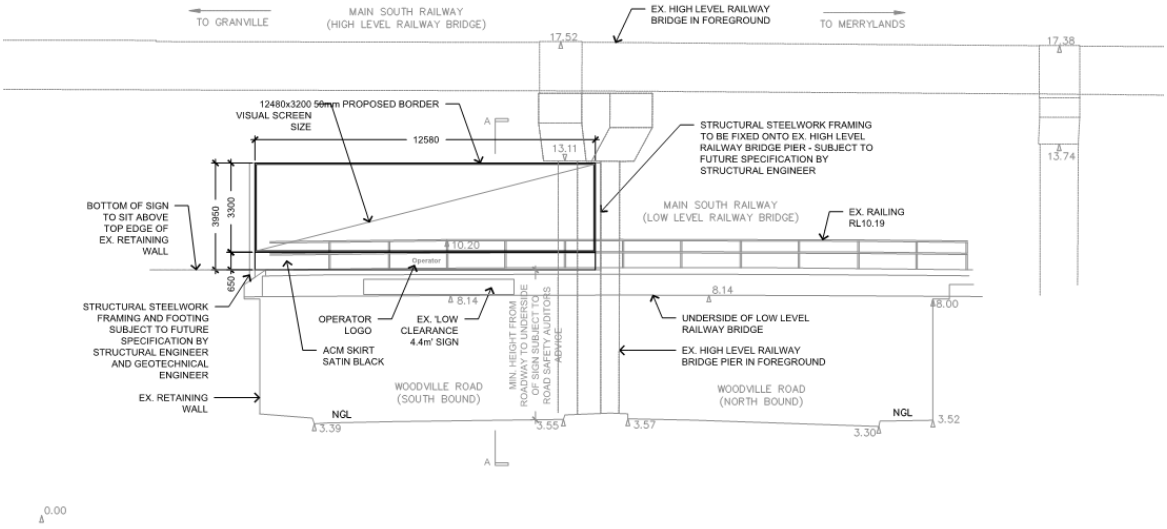


Figure 6.3 –Elevation sign 2 (north elevation)

The bridge mounted signs are located on the north and south sides of the railway overpass over Woodville Road. On the south side of the railway bridge, facing sign 1 there are number of low level residential properties, with a few commercial properties in between. Most of these properties are located at approximately the same level as the railway overpass. These residential properties are mostly 1 story properties. Number 2, 6, 8, 10, 9-11 (2 stories) 13 and 15 Woodville road face the sign on an angle, and were included in the calculations. Some of these properties have fences blocking the light. To the east of sign 1 there is a 3 story residential property on 121-127 Railway Parade, this property was included in the calculations. On the north side of the railway bridge, facing sign 2, there are a number of commercial properties.

Figure 6.4 – Plan showing residential sites

7. PARAMETERS

The proposed signs will be LED signs 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 (3.2m visual screen width)	
Overall Width	15.5m (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 signs we believe that the applicable environmental limits/zones and LTPs will be as follows:

	Sign 1	Sign 2
Environmental Zone to AS/NZS 4282	Zone A3	Zone A4
NSW Transport Corridor Advertising and Signage Guidelines	Zone 3	Zone 3
Maximum Vertical Illuminance – Non-Curfew	10 lx	25 lx
Maximum Vertical Illuminance – Curfew	2 lx	5 lx
Maximum Threshold Increment	20% @ L_{ad} =1	20% @ L_{ad} =5
Maximum average Luminance of Surface	250 cd/m²	350 cd/m²
Upward Light Output Ratio	50%	50%

Table 7.2 Applicable limits

8. METHODOLOGY

A site inspection was undertaken on 9 November 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.

If one of the LTPs failed to conform at an average luminance of 250 cd/m^2 for sign 1 or 350 cd/m^2 for sign 2, the average luminance of the sign was reduced to achieve conformance. 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.

9. CONFORMANCE

Table 9.1 summarises the results of the assessment and the level of conformance for sign 1 to environmental zone A3.

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 Daytime 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 (Zone A3)	250 cd/m^2	Level set to comply with threshold increment	174 cd/m^2 2.9% of Reference Level	YES
Maximum Average Luminance Curfew (Zone A3)	250 cd/m^2	Level set to comply with vertical illuminance	114 cd/m^2 1.9% of Reference Level	YES
Maximum Vertical illuminance Non-Curfew L1 (Zone A3)	10 lux	Level set to comply with threshold increment	3.1 lux 2.9% of Reference Level	YES
Maximum Vertical illuminance Curfew (Zone A3)	2 lux	Level set to comply	2.0 lux 1.9% of Reference Level	YES
Maximum Threshold Increment Result Non-Curfew L1 (Zone A3)	20% @ L_{ad} =1	Level set to comply	20% 2.9% of Reference Level	YES
Maximum Threshold Increment Result Curfew (Zone A3)	20% @ L_{ad} =1	Level set to comply with vertical illuminance	13% 1.9% of Reference Level	YES
CASA MoS Pt 139	Not Applicable in this location	N/A	N/A	YES
Upward Waste Light Ratio	50%		49.2%	49.2%

Table 9-1: Summary conformance sign 1 (zone A3)

Table 9.2 summarises the results of the assessment and the level of conformance for sign 2 to environmental zone A4.

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 Daytime 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 (Zone A4)	350 cd/m^2	Level set to comply with threshold increment & luminance	348 cd/m^2 5.8% or Reference Level	YES
Maximum Average Luminance Curfew (Zone A4)	350 cd/m^2	Level set to comply with threshold increment & luminance	348 cd/m^2 5.8% or Reference Level	YES
Maximum Vertical illuminance Non-Curfew L1 (Zone A4)	25 lux	N/A	N/A	N/A
Maximum Vertical illuminance Curfew (Zone A4)	5 lux	N/A	N/A	N/A
Maximum Threshold Increment Result Non-Curfew L1 (Zone A4)	20% @ L_{ad} =5	Level set to comply with threshold increment & luminance	20% 5.8% of Reference Level	YES
Maximum Threshold Increment Result Curfew (Zone A4)	20% @ L_{ad} =5	Level set to comply with threshold increment & luminance	20% 5.8% of Reference Level	YES
CASA MoS Pt 139	Not Applicable in this location	N/A	N/A	YES
Upward Waste Light Ratio	50%		49.2%	49.2%

Table 9-2: Summary conformance sign 2 (zone A4)

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 and 9.2.

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

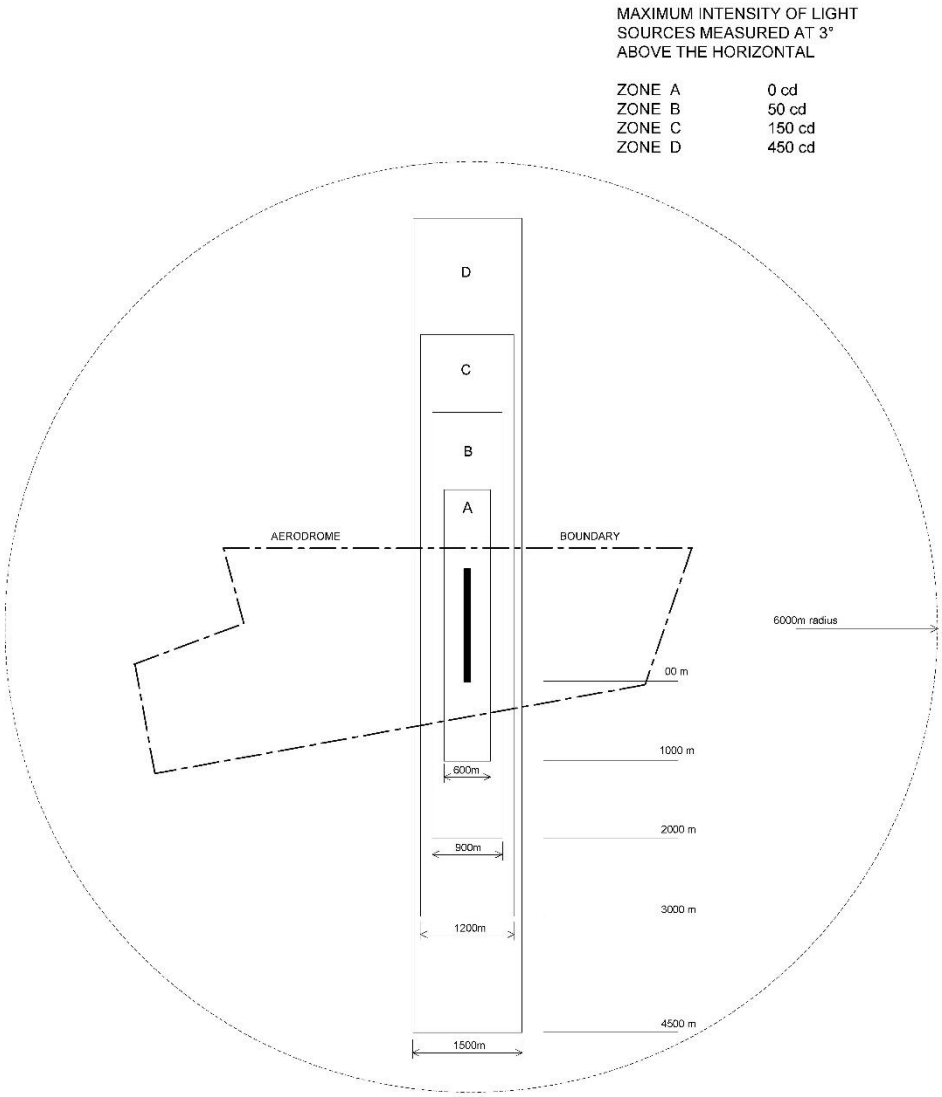


Figure 9.21-1: Maximum lighting intensities

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.

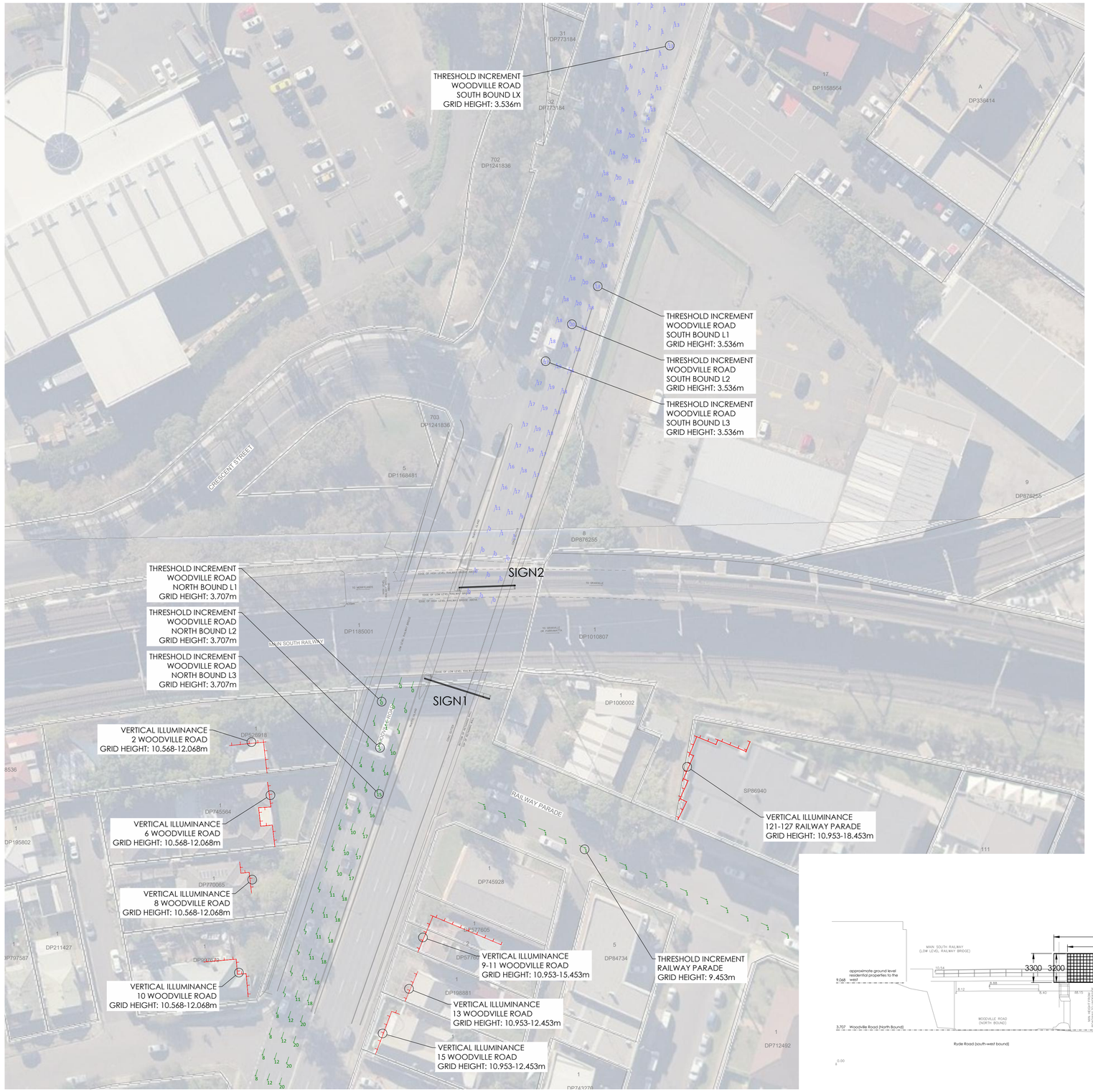
DISPLAY SPECIFICATION

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

201 Daktronics Dr PO Box 5128 Brookings, SD 57006-5128
tel 800-325-8766 605-697-4300 fax 605-697-4700
www.daktronics.com e-mail sales@daktronics.com

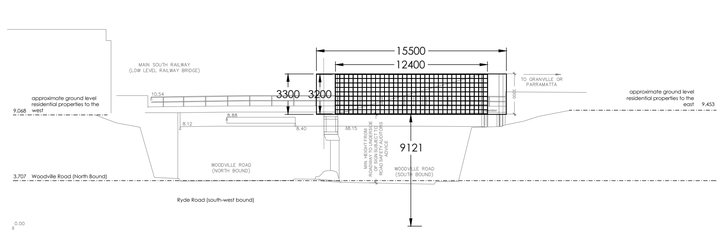
DAKTRONICS



PLAN VIEW

01

1:500@A1



INDICATIVE ELEVATION SIGN 1

02

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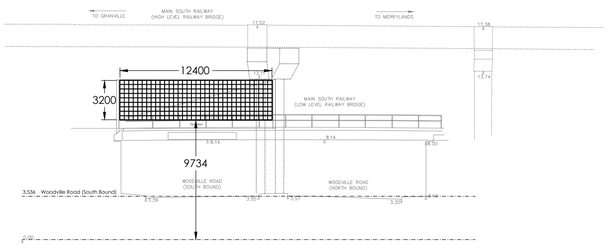

INDICATIVE ELEVATION SIGN 2

03

1:250@A1

Notes:
1. Final location of signs to be confirmed.
2. Observer height of Threshold Increment points: 1.5m.
3. Height of Vertical Illuminance calculations vary, and are noted on the drawing.
4. 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).

Issue	Amendment	Date
P1	PRELIMINARY ISSUE	27-11-20

N

AS SHOWN

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SITE 17
GRANVILLE
Obtrusive Lighting Compliance
Non-Curfew L1

Scope
The scope of the works for the installation of new billboard signage on both sides of the railway bridge on Woodville Road, Granville near Wallace Street is to comply with the requirements of AS/NZS 4282:2019, Category A3 for sign 1, and Category A4 for sign 2.

Category	A3 (sign 1)	A4 (sign 2)
Vertical Illuminance Non-Curfew L1	<10 lux	<25 lux
Vertical Illuminance Curfew	<2 lux	<5 lux
Threshold Increment	<20%	<20%
Threshold Increment adaptation level	1	5
Upward Waste Light Ratio	<50%	<50%

Scene Summary				
Scene: 0.29% & 0.58%				
Channel	**Label**	**Switched**	**Dimming**	**Height to bottom of sign**
Sign 1	SIGN 1	On	0.029	9.121m
Sign 2	SIGN 2	On	0.058	9.734m

Calculation Summary					
Project: Sign 1 - A3					
Scene: 0.29% & 0.58%					
Description	**CalcType**	**Units**	**Max**	**PtSpcLr**	**PtSpcTb**
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - II	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - II	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - II	Lux	0.3	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - II	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - II	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - II	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - II	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - II	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - II	Lux	0.1	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - II	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - II	Lux	0.2	2	1
ObtrusiveLight_A3 Woodville Rd 2	Obtrusive Light - II	Lux	0.2	2	1
ObtrusiveLight_A3 Woodville Rd 2	Obtrusive Light - II	Lux	2.0	2	1
ObtrusiveLight_A3 Woodville Rd 6	Obtrusive Light - II	Lux	2.0	2	1
ObtrusiveLight_A3 Woodville Rd 6	Obtrusive Light - II	Lux	1.2	2	1
ObtrusiveLight_A3 Woodville Rd 6	Obtrusive Light - II	Lux	1.9	2	1
ObtrusiveLight_A3 Woodville Rd 6	Obtrusive Light - II	Lux	0.0	2	1
ObtrusiveLight_A3 Woodville Rd 6	Obtrusive Light - II	Lux	2.1	2	1
ObtrusiveLight_A3 Woodville Rd 8	Obtrusive Light - II	Lux	1.4	2	1
ObtrusiveLight_A3 Woodville Rd 8	Obtrusive Light - II	Lux	1.0	2	1
ObtrusiveLight_A3 Woodville Rd 8	Obtrusive Light - II	Lux	1.4	2	1
ObtrusiveLight_A3 Woodville Rd 9-11	Obtrusive Light - II	Lux	3.1	2	1
ObtrusiveLight_A3 Woodville Rd 9-11	Obtrusive Light - II	Lux	0.8	2	1
ObtrusiveLight_A3 Woodville Rd 10	Obtrusive Light - II	Lux	0.9	2	1
ObtrusiveLight_A3 Woodville Rd 10	Obtrusive Light - II	Lux	1.0	2	1
ObtrusiveLight_A3 Woodville Rd 10	Obtrusive Light - II	Lux	0.9	2	1
ObtrusiveLight_A3 Woodville Rd 10	Obtrusive Light - II	Lux	0.9	2	1
ObtrusiveLight_A3 Woodville Rd 13	Obtrusive Light - II	Lux	0.0	2	1
ObtrusiveLight_A3 Woodville Rd 15	Obtrusive Light - II	Lux	1.6	2	1
ObtrusiveLight_A3 Woodville Rd 15	Obtrusive Light - II	Lux	0.0	2	1
ObtrusiveLight_TI_A3 Railway Pd	Obtrusive Light - TI	%	1	5	0
ObtrusiveLight_TI_A3 Woodville Rd NB L1	Obtrusive Light - TI	%	8	5	0
ObtrusiveLight_TI_A3 Woodville Rd NB L2	Obtrusive Light - TI	%	12	5	0
ObtrusiveLight_TI_A3 Woodville Rd NB L3	Obtrusive Light - TI	%	20	5	0

UWLR Area Summary	
Project: Sign 1 - A3	
Scene: 0.29% & 0.58%	
Label	**UWLR**
ULR Sign 1	0.492

Luminaire Schedule		
Project: Sign 1 - A3		
Scene: 0.29% & 0.58%		
Label	**Dimming**	**Luminance at dimming level**
SIGN 1	0.029	174 cd/m²

Obtrusive Light - Compliance Report

AS/NZS 4282:2019, A3 - Medium District Brightness, Non-Curfew L1
Filename: L164K-CL17A-Site 17 - Granville-Non-Curfew
27/11/2020 7:31:39 AM

Illuminance
Maximum Allowable Value: 10 Lux

Calculations Tested (30):

Calculation Label	Test Results	Max. Illum.
ObtrusiveLight_A3 Woodville Rd 6_III_Seg1	PASS	2.0
ObtrusiveLight_A3 Woodville Rd 6_III_Seg2	PASS	1.2
ObtrusiveLight_A3 Woodville Rd 6_III_Seg3	PASS	1.9
ObtrusiveLight_A3 Woodville Rd 6_III_Seg4	PASS	0.0
ObtrusiveLight_A3 Woodville Rd 6_III_Seg5	PASS	2.1
ObtrusiveLight_A3 Woodville Rd 2_III_Seg1	PASS	0.2
ObtrusiveLight_A3 Woodville Rd 2_III_Seg2	PASS	2.0
ObtrusiveLight_A3 Woodville Rd 8_III_Seg1	PASS	1.4
ObtrusiveLight_A3 Woodville Rd 8_III_Seg2	PASS	1.0
ObtrusiveLight_A3 Woodville Rd 8_III_Seg3	PASS	1.4
ObtrusiveLight_A3 Woodville Rd10_III_Seg1	PASS	0.9
ObtrusiveLight_A3 Woodville Rd10_III_Seg2	PASS	1.0
ObtrusiveLight_A3 Woodville Rd10_III_Seg3	PASS	0.9
ObtrusiveLight_A3 Woodville Rd10_III_Seg4	PASS	0.9
ObtrusiveLight_A3 Woodville Rd 9_III_Seg1	PASS	3.1
ObtrusiveLight_A3 Woodville Rd 9_III_Seg2	PASS	0.8
ObtrusiveLight_A3 Railway Pd 121_III_Seg1	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_III_Seg2	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_III_Seg3	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_III_Seg4	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_III_Seg5	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_III_Seg6	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_III_Seg7	PASS	0.1
ObtrusiveLight_A3 Railway Pd 121_III_Seg8	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_III_Seg9	PASS	0.2
ObtrusiveLight_A3 Railway Pd 121_III_Seg10	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_III_Seg11	PASS	0.3
ObtrusiveLight_A3 Woodville Rd13_III_Seg1	PASS	0.0
ObtrusiveLight_A3 Woodville Rd15_III_Seg1	PASS	1.6
ObtrusiveLight_A3 Woodville Rd15_III_Seg2	PASS	0.0

Threshold Increment (TI)
Maximum Allowable Value: 20 %

Calculations Tested (4):

Calculation Label	Adaptation Luminance	Test Results
ObtrusiveLight_TI_A3 Woodv Rd N1	1	PASS
ObtrusiveLight_TI_A3 Woodv Rd N2	1	PASS
ObtrusiveLight_TI_A3 Woodv Rd N3	1	PASS
ObtrusiveLight_TI_A3 Railway Pd	1	PASS

Calculation Summary					
Project: Sign 2 - A4					
Scene: 0.29% & 0.58%					
Description	**CalcType**	**Units**	**Max**	**PtSpcLr**	**PtSpcTb**
ObtrusiveLight_TI_A3 Woodville Rd SB L1	Obtrusive Light - TI	%	18	5	0
ObtrusiveLight_TI_A3 Woodville Rd SB L2	Obtrusive Light - TI	%	20	5	0
ObtrusiveLight_TI_A3 Woodville Rd SB L3	Obtrusive Light - TI	%	18	5	0
ObtrusiveLight_TI_A3 Woodville Rd SB X1	Obtrusive Light - TI	%	19	5	0

UWLR Area Summary	
Project: Sign 2 - A4	
Scene: 0.29% & 0.58%	
Label	**UWLR**
ULR Sign 2	0.492

Luminaire Schedule		
Project: Sign 2 - A4		
Scene: 0.29% & 0.58%		
Label	**Dimming**	**Luminance at dimming level**
SIGN 2	0.058	348 cd/m²

Obtrusive Light - Compliance Report

AS/NZS 4282:2019, A4 - High District Brightness, Non-Curfew L1
Filename: L164K-CL17A-Site 17 - Granville-Non-Curfew
27/11/2020 7:30:06 AM

Threshold Increment (TI)
Maximum Allowable Value: 20 %

Calculations Tested (4):

Calculation Label	Adaptation Luminance	Test Results
ObtrusiveLight_TI_A3 Woodv Rd S3	5	PASS
ObtrusiveLight_TI_A3 Woodv Rd S2	5	PASS
ObtrusiveLight_TI_A3 Woodv Rd S1	5	PASS
ObtrusiveLight_TI_A3 Woodv Rd SX	5	PASS

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Lead Consultant
ETHOS URBAN

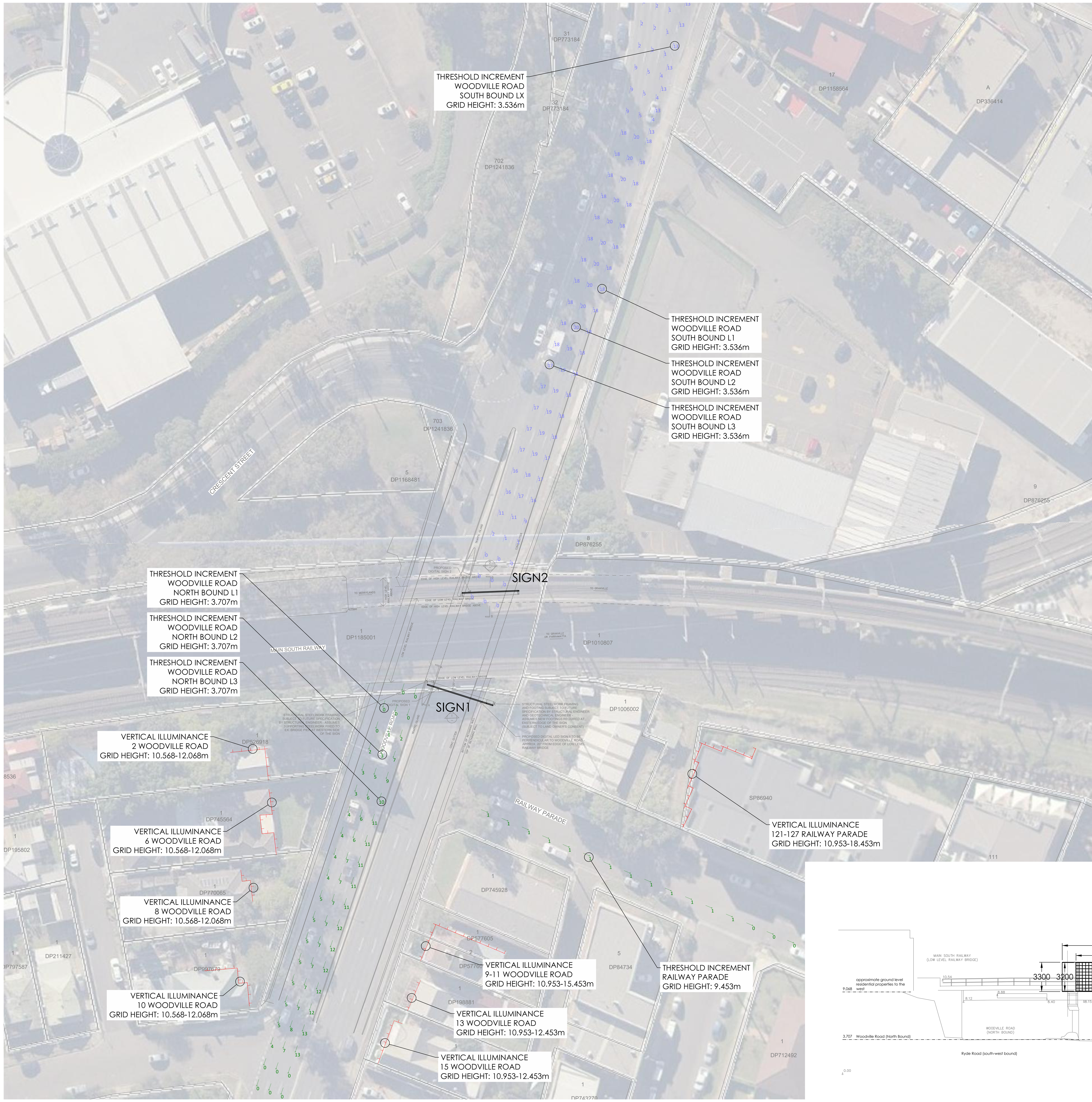
Client
SYDNEY TRAINS

Project SYDNEY TRAINS BILLBOARDS

Drawing SITE 17 - GRANVILLE
CALCULATIONS - NON-CURFEW - A3 & A4

Drawn	Approv.	Date	Scale
		NOV 2020	AS SHOWN

Project No	Drawing No	Rev
L164K	CL17A	P1



01 **PLAN VIEW**
1:500@A1

SITE 17
GRANVILLE
Obtrusive Lighting Compliance
Curfew

Scope

The scope of the works for the installation of new billboard signage on both sides of the railway bridge on Woodville Road, Granville near Wallace Street is to comply with the requirements of AS/NZS 4282:2019, Category A3 for sign 1, and Category A4 for sign 2.

Category	A3 (sign 1)	A4 (sign 2)
Vertical Illuminance Non-Curfew L1	<10 lux	<25 lux
Vertical Illuminance Curfew	<2 lux	<5 lux
Threshold Increment	<20%	<20%
Threshold Increment adaptation level	1	5
Upward Waste Light Ratio	<50%	<50%

Scene Summary
Scene: 0.19% & 0.58%

Channel	Label	Switched	Dimming	Height to bottom of sign
Sign 1	SIGN 1	On	0.019	9.121m
Sign 2	SIGN 2	On	0.058	9.734m

Calculation Summary
Project: Sign 1 - A3
Scene: 0.19% & 0.58%

Description	CalcType	Units	Max	PtSpcLr	PtSpcTb
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - Il	Lux	0.2	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Railway Pd 121-127	Obtrusive Light - Il	Lux	0.1	2	1
ObtrusiveLight_A3 Woodville Rd 2	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Woodville Rd 2	Obtrusive Light - Il	Lux	1.3	2	1
ObtrusiveLight_A3 Woodville Rd 6	Obtrusive Light - Il	Lux	1.3	2	1
ObtrusiveLight_A3 Woodville Rd 6	Obtrusive Light - Il	Lux	0.8	2	1
ObtrusiveLight_A3 Woodville Rd 6	Obtrusive Light - Il	Lux	1.2	2	1
ObtrusiveLight_A3 Woodville Rd 6	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Woodville Rd 6	Obtrusive Light - Il	Lux	1.4	2	1
ObtrusiveLight_A3 Woodville Rd 8	Obtrusive Light - Il	Lux	0.9	2	1
ObtrusiveLight_A3 Woodville Rd 8	Obtrusive Light - Il	Lux	0.6	2	1
ObtrusiveLight_A3 Woodville Rd 8	Obtrusive Light - Il	Lux	0.9	2	1
ObtrusiveLight_A3 Woodville Rd 9-11	Obtrusive Light - Il	Lux	2.0	2	1
ObtrusiveLight_A3 Woodville Rd 9-11	Obtrusive Light - Il	Lux	0.2	2	1
ObtrusiveLight_A3 Woodville Rd 10	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Woodville Rd 10	Obtrusive Light - Il	Lux	0.1	2	1
ObtrusiveLight_A3 Woodville Rd 10	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Woodville Rd 10	Obtrusive Light - Il	Lux	0.1	2	1
ObtrusiveLight_A3 Woodville Rd 13	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_A3 Woodville Rd 15	Obtrusive Light - Il	Lux	1.1	2	1
ObtrusiveLight_A3 Woodville Rd 15	Obtrusive Light - Il	Lux	0.0	2	1
ObtrusiveLight_TI_A3 Railway Pd	Obtrusive Light - TI	%	1	5	0
ObtrusiveLight_TI_A3 Woodville Rd NB L1	Obtrusive Light - TI	%	5	5	0
ObtrusiveLight_TI_A3 Woodville Rd NB L2	Obtrusive Light - TI	%	8	5	0
ObtrusiveLight_TI_A3 Woodville Rd NB L3	Obtrusive Light - TI	%	13	5	0

UWLR Area Summary
Project: Sign 1 - A3
Scene: 0.19% & 0.58%

Label	UWLR
ULR Sign 1	0.492

Luminaire Schedule
Project: Sign 1 - A3
Scene: 0.19% & 0.58%

Label	Dimming	Luminance at dimming level
SIGN 1	0.019	114 cd/m²

Obtrusive Light - Compliance Report

AS/NZS 4282:2019, A3 - Medium District Brightness, Curfew
Filename: L164K-CL17B-Site 17 - Granville-Curfew
27/11/2020 7:36:46 AM

Illuminance

Maximum Allowable Value: 2 Lux

Calculations Tested (30):

Calculation Label	Test Results	Max. Illum.
ObtrusiveLight_A3 Woodville Rd 6_Ill_Seg1	PASS	1.3
ObtrusiveLight_A3 Woodville Rd 6_Ill_Seg2	PASS	0.8
ObtrusiveLight_A3 Woodville Rd 6_Ill_Seg3	PASS	1.2
ObtrusiveLight_A3 Woodville Rd 6_Ill_Seg4	PASS	0.0
ObtrusiveLight_A3 Woodville Rd 6_Ill_Seg5	PASS	1.4
ObtrusiveLight_A3 Woodville Rd 2_Ill_Seg1	PASS	0.0
ObtrusiveLight_A3 Woodville Rd 2_Ill_Seg2	PASS	1.3
ObtrusiveLight_A3 Woodville Rd 8_Ill_Seg1	PASS	0.9
ObtrusiveLight_A3 Woodville Rd 8_Ill_Seg2	PASS	0.6
ObtrusiveLight_A3 Woodville Rd 8_Ill_Seg3	PASS	0.9
ObtrusiveLight_A3 Woodville Rd10_Ill_Seg1	PASS	0.0
ObtrusiveLight_A3 Woodville Rd10_Ill_Seg2	PASS	0.1
ObtrusiveLight_A3 Woodville Rd10_Ill_Seg3	PASS	0.0
ObtrusiveLight_A3 Woodville Rd10_Ill_Seg4	PASS	0.1
ObtrusiveLight_A3 Woodville Rd 9_Ill_Seg1	PASS	2.0
ObtrusiveLight_A3 Woodville Rd 9_Ill_Seg2	PASS	0.2
ObtrusiveLight_A3 Railway Pd 121_Ill_Seg1	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_Ill_Seg2	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_Ill_Seg3	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_Ill_Seg4	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_Ill_Seg5	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_Ill_Seg6	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_Ill_Seg7	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_Ill_Seg8	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_Ill_Seg9	PASS	0.1
ObtrusiveLight_A3 Railway Pd 121_Ill_Seg10	PASS	0.0
ObtrusiveLight_A3 Railway Pd 121_Ill_Seg11	PASS	0.2
ObtrusiveLight_A3 Woodville Rd13_Ill_Seg1	PASS	0.0
ObtrusiveLight_A3 Woodville Rd15_Ill_Seg1	PASS	1.1
ObtrusiveLight_A3 Woodville Rd15_Ill_Seg2	PASS	0.0

Threshold Increment (TI)

Maximum Allowable Value: 20 %

Calculations Tested (4):

Calculation Label	Adaptation Luminance	Test Results
ObtrusiveLight_TI_A3 Woodv Rd N1	1	PASS
ObtrusiveLight_TI_A3 Woodv Rd N2	1	PASS
ObtrusiveLight_TI_A3 Woodv Rd N3	1	PASS
ObtrusiveLight_TI_A3 Railway Pd	1	PASS

Calculation Summary
Project: Sign 2 - A4
Scene: 0.19% & 0.58%

Description	CalcType	Units	Max	PtSpcLr	PtSpcTb
ObtrusiveLight_TI_A3 Woodville Rd SB L1	Obtrusive Light - TI	%	18	5	0
ObtrusiveLight_TI_A3 Woodville Rd SB L2	Obtrusive Light - TI	%	20	5	0
ObtrusiveLight_TI_A3 Woodville Rd SB L3	Obtrusive Light - TI	%	18	5	0
ObtrusiveLight_TI_A3 Woodville Rd SB X1	Obtrusive Light - TI	%	19	5	0

UWLR Area Summary
Project: Sign 2 - A4
Scene: 0.19% & 0.58%

Label	UWLR
ULR Sign 2	0.492

Luminaire Schedule
Project: Sign 2 - A4
Scene: 0.19% & 0.58%

Label	Dimming	Luminance at dimming level
SIGN 2	0.058	348 cd/m²

Obtrusive Light - Compliance Report

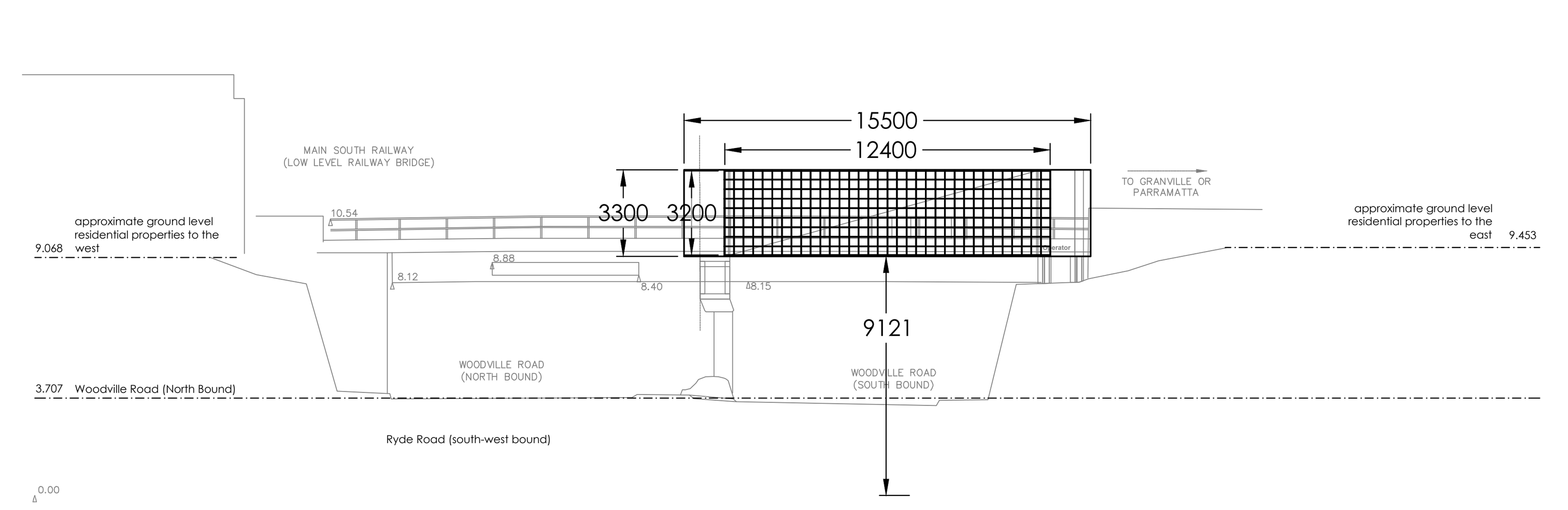
AS/NZS 4282:2019, A4 - High District Brightness, Curfew
Filename: L164K-CL17B-Site 17 - Granville-Curfew
27/11/2020 7:36:08 AM

Threshold Increment (TI)

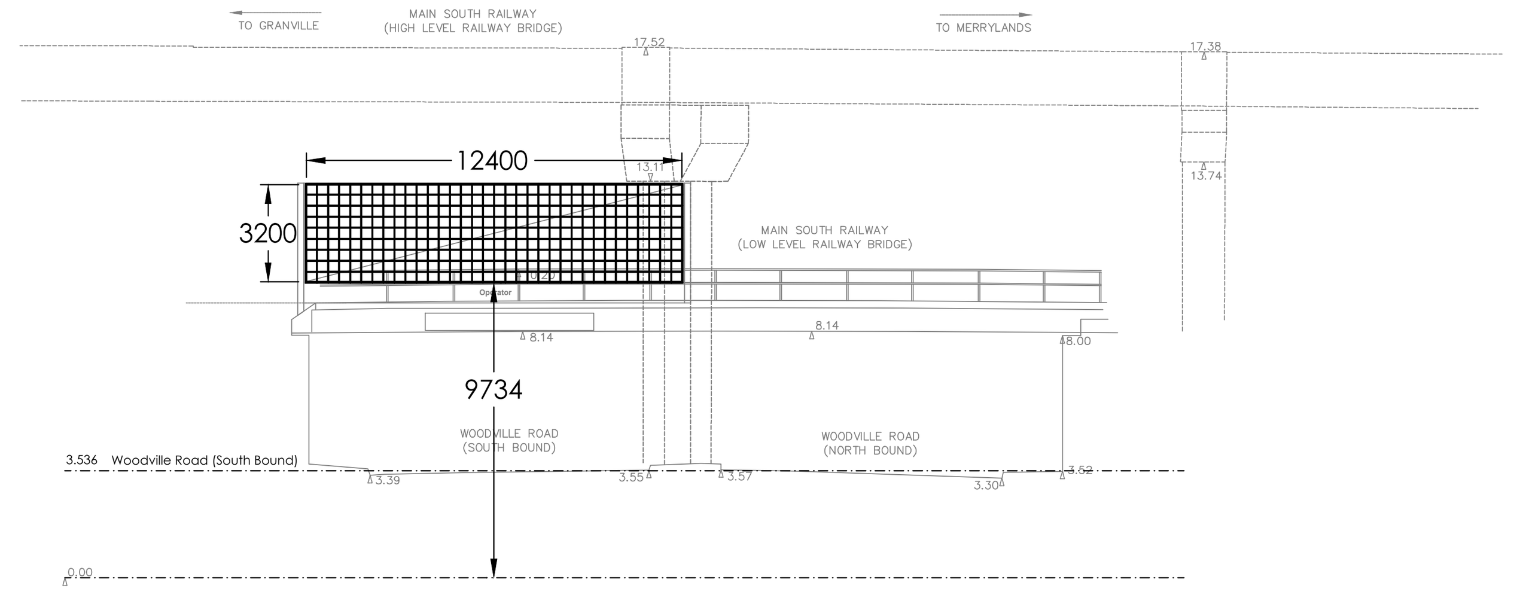
Maximum Allowable Value: 20 %

Calculations Tested (4):

Calculation Label	Adaptation Luminance	Test Results
ObtrusiveLight_TI_A3 Woodv Rd S3	5	PASS
ObtrusiveLight_TI_A3 Woodv Rd S2	5	PASS
ObtrusiveLight_TI_A3 Woodv Rd S1	5	PASS
ObtrusiveLight_TI_A3 Woodv Rd SX	5	PASS



02 **INDICATIVE ELEVATION SIGN 1**
1:250@A1



03 **INDICATIVE ELEVATION SIGN 2**
1:250@A1

Issue	Amendment	Date
P1	PRELIMINARY ISSUE	27-11-20

N

AS SHOWN

Notes:
1. Final location of signs to be confirmed.
2. Observer height of Threshold Increment points: 1.5m.
3. Height of Vertical Illuminance calculations vary, and are noted on the drawing.
4. 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
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Project: SYDNEY TRAINS BILLBOARDS
Drawing: SITE 17 - GRANVILLE CALCULATIONS - CURFEW - A3 & A4
Drawn | Approv. | Date NOV 2020 | Scale AS SHOWN
Project No L164K | Drawing No CL17B | Rev P1

T:\Projects\L164\L164K - Sydney Train Billboards\L164K-DG\L164K-CL17-Site 17 Granville.dwg - 17B - 27/11/2020 - 8:49:07 AM