

JCDecaux
Ref: 3023.5

LIGHTING IMPACT ASSESSMENT
OUTDOOR SIGNAGE ON THE
RAIL BRIDGE OVER GEORGE ST, SYDNEY

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1. INTRODUCTION

Electrolight have been appointed by JCDecaux to undertake a Lighting Impact Assessment on the proposed digital signage to be installed on the rail bridge over George St, Sydney, NSW (**proposed signage**). The objective of the assessment is to report on compliance with the State Environmental Planning Policy (Industry and Employment) 2021, NSW Transport Corridor Outdoor Advertising and Signage Guidelines, AS/NZS 4282:2023 Control of the Obtrusive Effects of Outdoor Lighting, and the Sydney Development Control Plan (Signs and Advertisements) 2012.

2. DEFINITIONS

2.1 Illuminance

The physical measure of illumination is illuminance. It is the luminous flux arriving at a surface divided by the area of the illuminated surface. Unit: lux (lx); 1 lx = 1 lm/m².

- (a) Horizontal illuminance (E_h) The value of illuminance on a designated horizontal plane
- (b) Vertical illuminance (E_v) The value of illuminance on a designated vertical plane

Where the vertical illuminance is considered in the situation of potentially obtrusive light at a property boundary it can be referred to as environmental vertical illuminance (E_{ve}).

2.2 Luminance

The physical quantity corresponding to the brightness of a surface (e.g. a lamp, luminaire or reflecting material such as the road surface) when viewed from a specified direction. SI Unit: candela per square metre (cd/m²) – also referred to as “nits”.

2.3 Luminous Intensity

The concentration of luminous flux (perceived light power) emitted in a specified direction. Unit: candela (cd).

2.4 Dynamic content

Where the luminous image, pattern, colour or direction of light changes over an interval of less than 60 seconds.

Note: Definition sourced from AS4282:2023.

2.5 Obtrusive Light

Spill light which, because of quantitative or directional attributes, gives rise to annoyance, discomfort, distraction, or a reduction in ability to see essential information such as transport signals.

Note: Obtrusive light includes the impact on humans and environmental receivers.

2.6 Threshold Increment

The measure of disability glare expressed as the percentage increase in luminance contrast threshold required between an object and its background for it to be seen equally well with a source of glare present.

Note: The required value is a maximum for compliance of the lighting scheme.

2.7 Environmentally Sensitive Area (ESA)

Area of ecological value including, bushland, waterways and marine and coastal areas.

Note: Definition sourced from AS4282:2023.

2.8 AGI32 Light Simulation Software

AGI32 (by U.S. company Lighting Analysts/Revalize) is an industry standard lighting simulation software package that can accurately model and predict the amount of light reaching a designated surface or workplane. AGI32 has been independently tested against the International Commission On Illumination (CIE) benchmark, CIE 171:2006, Test Cases to Assess the Accuracy of Lighting Computer Programs.

2.9 Upward Light Ratio Luminaire (ULR_L)

The ratio of the luminous flux of a luminaire that is emitted, at and above the horizontal, divided by the total luminaire flux when the luminaire is mounted in its designed position, and excluding reflected light from surfaces or obstructions.

Note: Definition sourced from AS4282:2023.

2.10 Environmental Receiver

Any identified living species (plants, animals and other organisms) and their locations indicated, that may be impacted by the proposed lighting system.

Note: Definition sourced from AS4282:2023.

3. SITE DESCRIPTION AND SCOPE

The proposed signage is located on the southern elevation of the rail bridge over George St, Sydney. The signage is oriented towards the northbound direction of traffic on George St and shall replace the existing internally illuminated signage currently on the site. The total area of the signage is approximately 16.25 m². Refer to Appendix A for the signage location plan, elevations and photomontages.

The proposed signage is illuminated using LEDs installed within the front face. The brightness of the LEDs shall be controlled to provide upper and lower thresholds as required as well as automatically via a local light sensor to adjust to ambient lighting conditions. The dwell time of the content displayed on the signage is 25 seconds and it is to operate 24 hours per day. As the dwell time of the content displayed on the signage is less than 60 seconds, it is defined as being dynamic content (see Section 2.4).

For the purpose of this report, the specification of the proposed signage is as outlined in Appendix B. The signage includes baffles which mitigate upward waste light, resulting in an Upward Light Ratio (ULR_L) of not more than 0.45*. Alternative digital sign manufacturers may be used for this installation as long as they have equivalent lighting and performance characteristics and are commissioned as described in this report.

Environmental impact assessments, including the management of artificial light for the protection of specific entities protected by environmental legislation, is beyond the scope of this assessment.

*The signage supplier and/or operator is responsible for complying with the Upward Light Ratio. Electrolight take no responsibility for compliance with this requirement.

4. DESIGN GUIDELINES AND STANDARDS

The Lighting Impact Assessment will review the proposed signage against the following Criteria, Design Guidelines and Standards.

- State Environmental Planning Policy (Industry and Employment) 2021 (**SEPP Industry and Employment**)
- Transport Corridor Outdoor Advertising & Signage Guidelines 2017 (**Transport Guidelines**)
- AS/NZS 4282:2023 Control of the Obtrusive Effects of Outdoor Lighting (**AS4282**)
- Sydney Development Control Plan (Signs and Advertisements) 2012 (**Sydney DCP**)

5. LUMINANCE ASSESSMENT

The maximum permissible night time luminance of the proposed signage is determined by the existing lighting environment and the land use zoning of its surroundings. AS4282 outlines maximum average luminances for different Environmental Zones as shown in Table 1 below:

TABLE 1 - AS4282 MAXIMUM AVERAGE NIGHT TIME LUMINANCE FOR SIGNAGE		
	Description	Max Average Luminance (cd/m2)
A4	High district brightness e.g. Town and city centres and other commercial areas, residential areas abutting commercial areas, industrial and Port areas and Transport Interchanges	350
A3	Medium district brightness e.g. Suburban areas in towns and cities, generally roadways with streetlighting through suburban, rural or semi-rural areas	250
A2	Low district brightness e.g. Sparsely inhabited rural and semi-rural areas, generally roadways without streetlighting through suburban, rural or semi-rural areas other than intersections	150
A1	Dark e.g. Relatively uninhabited rural areas (including terrestrial, marine, aquatic and coastal areas), generally roadways without streetlighting through rural areas	50
A0	Intrinsically Dark e.g. UNESCO Starlight Reserve, IDA: Dark Sky Parks, Reserves or Sanctuaries, major optical observatories, other accreditations for dark sky places for example astrotourism, heritage value, astronomical importance, wildlife/ ecosystem protection, lighting for safe access may be required	0.1

Based on an assessment of the surrounding environment, the proposed signage is located within Environmental Zone A4 under AS4282, therefore, the maximum night time luminance is 350cd/m2.

AS4282 does not include limits for daytime operation of illuminated signage. However, the Transport Guidelines outlines maximum permissible luminance limits for various lighting conditions, including daytime. Under the Transport Guidelines, the proposed signage is classified as being within Zone 1 which is described as an area with generally very high off street ambient lighting, e.g. display centres similar to Kings Cross in Sydney, and Central Business District locations. The maximum luminance limits of digital signage within Zone 1 are: no limit for full sun on face of sign, no limit during the day, 700cd/m2 for twilight and overcast weather and 350cd/m2 for night time.

The Sydney DCP also outlines maximum permissible luminance limits for various lighting conditions. Under the Sydney DCP, the proposed screen is classified as being within a Business or Industrial zone within 100m of an accomodation land use. The maximum luminances of the digital signage for the various lighting conditions under the DCP are: 6000 cd/m2 during daylight hours, 600 cd/m2 during twilight hours and inclement weather, and 200 cd/m2 during night time hours.

Table 2 below outlines the maximum luminance levels to comply with AS4282, the Transport Corridor Guidelines and the Sydney DCP for the various lighting conditions listed below:

TABLE 2 - LUMINANCE LEVELS FOR DIGITAL ADVERTISEMENTS		
Lighting Condition	Max Permissible Luminance (cd/m2) [#]	Compliant
Full Sun on face of Signage	6000	✓
Day Time Luminance (typical sunny day)	6000	✓
Overcast Weather	600	✓
Twilight	600	✓
Night Time	200	✓

[#]The signage is to be dimmed on site to ensure the maximum luminance nominated above is not exceeded.

6. AS4282 ASSESSMENT AND SYDNEY DCP ASSESSMENT

The proposed signage has been assessed against the lighting criteria and requirements outlined in AS4282 and the Sydney DCP.

Illuminance Assessment (AS4282)

AS4282 provides limits for different obtrusive factors associated with dark hours (night time) operation of outdoor lighting systems. Two sets of limiting values for spill light are given based on whether the lighting is operating before a curfew (known as “pre-curfew” operation) or operating after a curfew (known as post-curfew or curfewed operation). Pre-curfew spill lighting limits are higher than post-curfew values, on the understanding that spill light is more obtrusive late at night when residents are trying to sleep. Under AS4282, the post-curfew period is taken to be between 11pm and 6am daily. As the proposed signage shall operate all night, it will be assessed against the more stringent post-curfew limits.

Spill light to any adjacent Environmentally Sensitive Areas are assessed against the more stringent post-curfew limits, as outlined in Clause 3.2.1 of AS4282.

Illuminance Assessment

The AS4282 assessment includes a review of nearby residential dwellings and Environmentally Sensitive Areas and calculation of the amount of vertical illuminance (measured in Lux) that they are likely to receive from the signage during night time operation.

The acceptable level of vertical illuminance will in part be determined by the night time lighting environment around the dwellings. AS4282 categorises the night time environment into different zones with maximum lighting limits as shown in Table 3 below:

TABLE 3 - AS4282 MAXIMUM VALUES OF VERTICAL ILLUMINANCE			
	Max Vertical Illuminance (lx)		Description
	Pre-curfew	Post-curfew	
A4	25	5	High district brightness e.g. Town and city centres and other commercial areas, residential areas abutting commercial areas, industrial and Port areas and Transport Interchanges
A3	10	2	Medium district brightness e.g. Suburban areas in towns and cities, generally roadways with streetlighting through suburban, rural or semi-rural areas
A2	5	1	Low district brightness e.g. Sparsely inhabited rural and semi-rural areas, generally roadways without streetlighting through suburban, rural or semi-rural areas other than intersections
A1	2	0.1	Dark e.g. Relatively uninhabited rural areas (including terrestrial, marine, aquatic and coastal areas), generally roadways without streetlighting through rural areas
A0	0	0	Intrinsically Dark e.g. UNESCO Starlight Reserve, IDA: Dark Sky Parks, Reserves or Sanctuaries, major optical observatories, other accreditations for dark sky places for example astrotourism, heritage value, astronomical importance, wildlife/ecosystem protection, lighting for safe access may be required

Where the signage displays dynamic content (a dwell time less than 60 seconds) and is located within 100m of residential dwelling/s with potential views to the signage, then the maximum allowable vertical illuminance limits to the impacted dwellings are 50% of those outlined in Table 3 above. Where the dwellings are further than 100m from the signage, the maximum vertical limits are those values shown in Table 3.

Residential Dwellings

Based on an assessment of the surrounding areas, the nearest dwellings with potential views to the signage are at the following locations:

Address	Zone	Within 100m	Address	Zone	Within 100m
199 George St	A4	Yes	1 Alfred St, Towers A and B*	A4	Yes

*The nominated property is under development. Calculation grids were placed along the proposed facade of the building in accordance with the approved development plans.

As such, the dwellings above will form the focus of the illuminance assessment.

The signage (and surrounding environment) was modelled in lighting calculation program AGI32 to determine the effect (if any) of the light spill from the proposed signage. Photometric data for the signage was provided by the manufacturer* with the maximum luminance corresponding to the night time limit outlined in Section 5. Appendix C shows the lighting model and the results of the calculations.

Under AS4282, the maximum allowable vertical illuminance to dwellings at a distance of 100m or greater from signage displaying dynamic content is 5 lux for Zone A4 (as outlined in Table 3). There are no impacted dwellings at a distance of 100m or greater from the signage.

Where dwellings are within 100m from signage displaying dynamic content, the maximum illuminance is 50% of the limits outlined in Table 3, namely 2.5 lux for Zone A4. It can be seen from the lighting model that the maximum illuminance for Zone A4 properties within 100m from the signage is 1.82 lux at 1 Alfred St, Tower A.

Illuminance Assessment (Sydney DCP)

Table 3.9 of the Sydney DCP outlines maximum illuminance limits on windows on habitable rooms of the accomodation uses in the vicinity of digital (electronic) signage. The maximum illuminance from a digital sign to windows of habitable rooms of an accomodation use is not to exceed 2 lux, or not be greater than the illuminance from existing advertising structure (whichever is less).

It can be seen from the lighting model in Appendix C that the maximum illuminance to habitable windows from the proposed signage is 1.82 lux. This illuminance level is less than the 2 lux maximum as outlined in Table 3.9 of the DCP.

In addition to the 2 lux maximum limit under the DCP, the proposed signage is not to exceed the current vertical illuminance (light spill) of the existing signage. This effectively means that, for signs of comparable size, the luminance of the proposed signage must be equal to or less than the luminance of the existing signage. In order to determine the maximum luminance of the existing signage, site measurements are required with the signage displaying a 100% white image. This process can be quite complex and expensive, so it has been proposed that a condition be included in the consent that requires these measurements to be undertaken and for the new signage to be commissioned to the same luminance level as the existing sign- refer Appendix E. This would satisfy the requirement outlined in Table 3.9 of the Sydney DCP for signs located in a Business or Industrial Zone within 100m of an accommodation land use. The proposed signage would then comply with all relevant lighting limits of the Sydney DCP 2012. Noting the above, Table 4 below outlines the final maximum luminance levels to comply with AS4282, the Transport Corridor Outdoor Advertising & Signage Guidelines, and the Sydney DCP 2012:

* Electrolight takes no responsibility for the accuracy of third party provided photometric data.

TABLE 4 - LUMINANCE LEVELS FOR DIGITAL ADVERTISEMENTS		
Lighting Condition	Max Permissible Luminance (cd/m ²) [#]	Compliant
Full Sun on face of Signage	6000	✓
Day Time Luminance (typical sunny day)	6000	✓
Overcast Weather	600	✓
Twilight	600	✓
Night Time	200 AND ≤ Existing Signage refer Appendix E	✓

Environmentally Sensitive Areas

No Environmentally Sensitive Areas were identified in the vicinity of the proposed signage. The limits in AS4282 therefore do not apply.

Threshold Increment Assessment (AS4282)

The Threshold Increment was calculated during night time operation for the traffic approaches on George St (northbound), Essex St left turn to George St (northbound) and the Lightrail approach on George St (northbound), in order to demonstrate compliance with the requirements of AS4282. The calculation grids were located at 1.5m above ground level for general traffic approaches and 2m above ground level for Lightrail approaches, with the approach viewing distance of between 10m to 200m from the sign. Using an adaptation Luminance of 5 cd/m² for night time, the calculation results show that the Threshold Increment does not exceed 10.03% for any traffic approach (the allowable maximum under the standard is 20%).

Threshold Increment Assessment (Sydney DCP)

The Threshold Increment was also calculated during twilight and night time operation for the traffic approaches on George St (northbound), Essex St left turn to George St (northbound) and the Lightrail approach on George St (northbound), in order to demonstrate compliance with the requirements of the Sydney DCP. The calculation grids were located at 1.5m above ground level for general traffic approaches and 2m above ground level for Lightrail approaches with the approach viewing distance of between 10m to 200m from the sign. For calculation purposes, an adaptation luminance of 10 cd/m² for was used for Twilight operation (in accordance with the DCP), however a lower adaptation of 5 cd/m² was used for night time operation (rather than 10 cd/m² as outlined in the DCP) in line with the more conservative requirements of the current revision of AS4282. The value of Threshold Increment that is calculated with an adaptation luminance of 5 cd/m² will be higher than that calculated with an adaptation luminance of 10 cd/m². As such, if the calculated value of Threshold Increment limit complies with the 20% limit at 5 cd/m², it will also comply with the 20% limit with an adaptation luminance of 10 cd/m². The calculation results show that, for twilight operation, the Threshold Increment does not exceed 17.06% for any traffic approach, and for night time operation the Threshold increment does not exceed 10.03% for any traffic approach (the allowable maximum under the standard is 20%).

Upward Waste Light Assessment

In order to reduce light pollution and associated environmental impacts, AS4282 includes requirements that limit upward waste light into the night sky from signage. Clause 3.3.3.b) of AS4282 states that digital signage shall have an Upward Waste Light Ratio (ULR_s) of not more than 0.45. The ULR_s of the specified signage is not more than 0.401. The signage therefore complies with this requirement.

Luminous Intensity

The luminous intensity limits nominated in the standard are not applicable for internally illuminated signage.

Additional Requirements (Sydney DCP)

Section 3 Clause 3.16.7.2.4.e) of the Sydney DCP states that digital signage shall have a maximum horizontal viewing angle of 160 degrees (+80 degrees and -80 degrees) and a maximum vertical viewing angle of 70 degrees (+25 degrees and -45 degrees). The proposed signage has a horizontal viewing angle of 160 degrees (+80 degrees and -80 degrees) and a maximum vertical angle of 70 degrees (+25 degrees and -45 degrees) - refer Appendix B for details. The signage therefore complies with the viewing angles requirements of the Sydney DCP.

Summary:

It can therefore be seen that the proposed signage complies with all relevant requirements of AS4282 and the Sydney DCP.

7. SEPP ASSESSMENT

Table 5 below outlines the illumination assessment criteria from the SEPP Industry and Employment Schedule 5 - Clause 7 Illumination. In addition to the criteria, responses have been included demonstrating that the proposed signage is in compliance.

TABLE 5 - ILLUMINATION ASSESSMENT CRITERIA		
Assessment Criteria	Response	Compliant?
Would illumination result in unacceptable glare?	The proposed signage complies with the Threshold Increment limits of AS4282, demonstrating that the illumination will not cause unacceptable glare.	✓
Would illumination affect safety for pedestrians, vehicles or aircraft?	The proposed signage complies with the Threshold Increment limits of AS4282, demonstrating that the illumination will not cause unacceptable glare. The size of the signage and its relatively low intensity limits the risk to pedestrians, vehicles or aircraft.	✓
Would illumination detract from the amenity of any residence or other form of accommodation?	The proposed signage, when installed according to this report, complies with the illuminance (spill lighting) limits of AS4282, demonstrating that the illumination will not detract from the amenity of any residence or other form of accommodation.	✓
Can the intensity of the illumination be adjusted, if necessary?	The proposed signage is dimmable and when designed according to this report, includes a light sensor that automatically adjusts the brightness of the advertising display to prevailing light conditions.	✓
Is the illumination subject to a curfew?	The proposed advertising signage, when installed according to this report, complies with the limits required during curfewed operation under AS4282 (nominally between the hours of 11pm and 6am). This means that a curfew is not required.	N/A

8. SUMMARY

- The proposed signage to be installed on the rail bridge over George St, Sydney shall be commissioned on site to yield the following maximum luminances:

COMPLYING LUMINANCE LEVELS FOR DIGITAL ADVERTISEMENTS		
Lighting Condition	Max Permissible Luminance (cd/m2)	Compliant
Full Sun on face of Signage	6000	✓
Day Time Luminance (typical sunny day)	6000	✓
Overcast Weather	600	✓
Twilight	600	✓
Night Time	200 AND <= Existing Signage refer Appendix E	✓

- The proposed signage has been found to comply with all relevant requirements of AS4282, the Transport Guidelines, SEPP Industry and Employment and the Sydney DCP 2012.
- In complying with the above requirements, the proposed signage shall not result in unacceptable glare nor shall it adversely impact the safety of pedestrians, residents or vehicular traffic. Additionally, the signage shall not cause any unacceptable amenity impacts to nearby residential dwellings, accommodation or environmental receivers.

9. DESIGN CERTIFICATION

The proposed signage to be installed on the rail bridge over George St, Sydney, NSW if commissioned according to this report, complies with the following criteria, guidelines and standards:

- State Environmental Planning Policy (Industry and Employment) 2021
- Transport Corridor Outdoor Advertising & Signage Guidelines 2017
- AS/NZS 4282:2023 Control of the Obtrusive Effects of Outdoor Lighting
- Sydney Development Control Plan (Signs and Advertisement) 2012*



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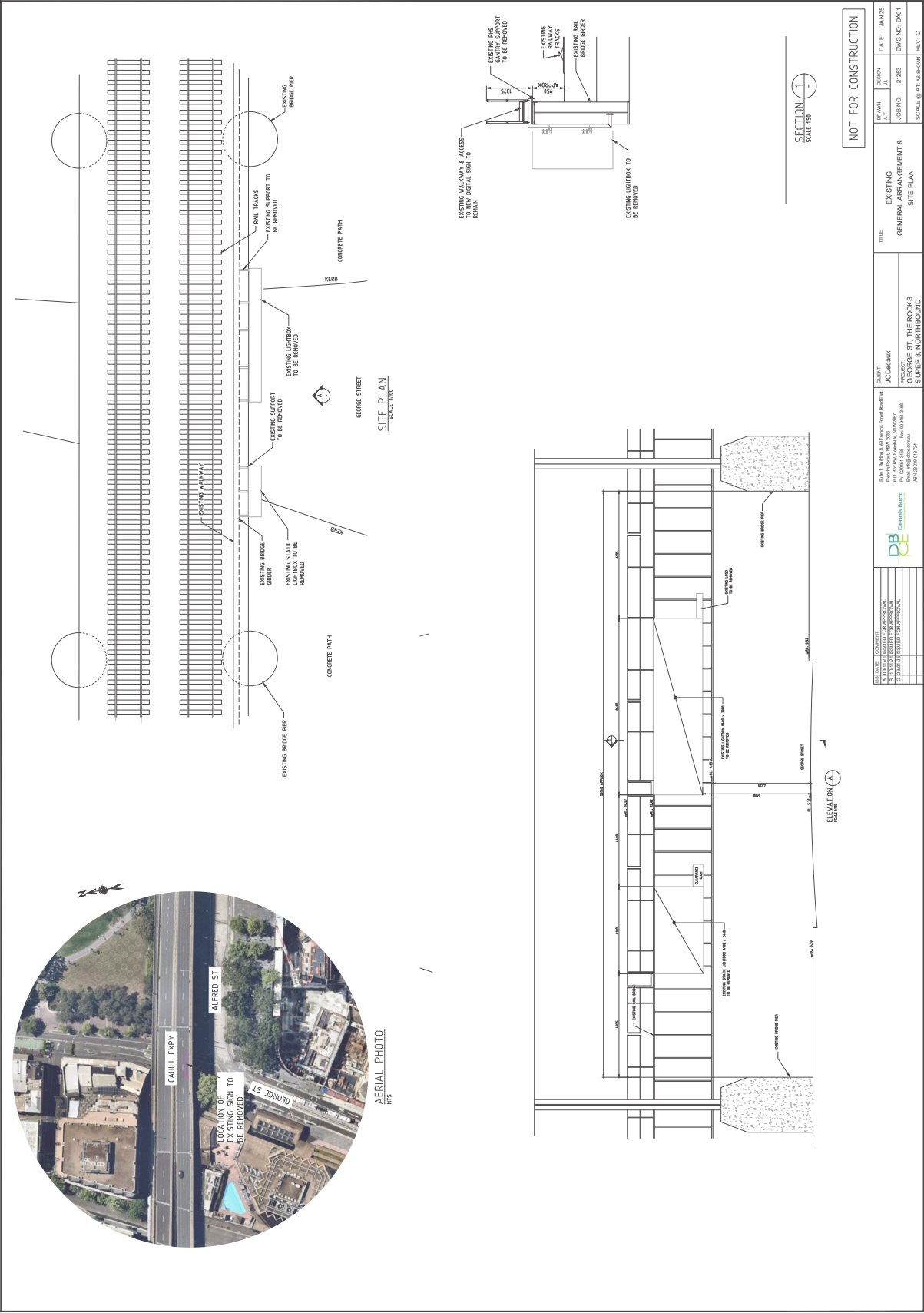
Senior Lighting Designer

Electrolight Sydney

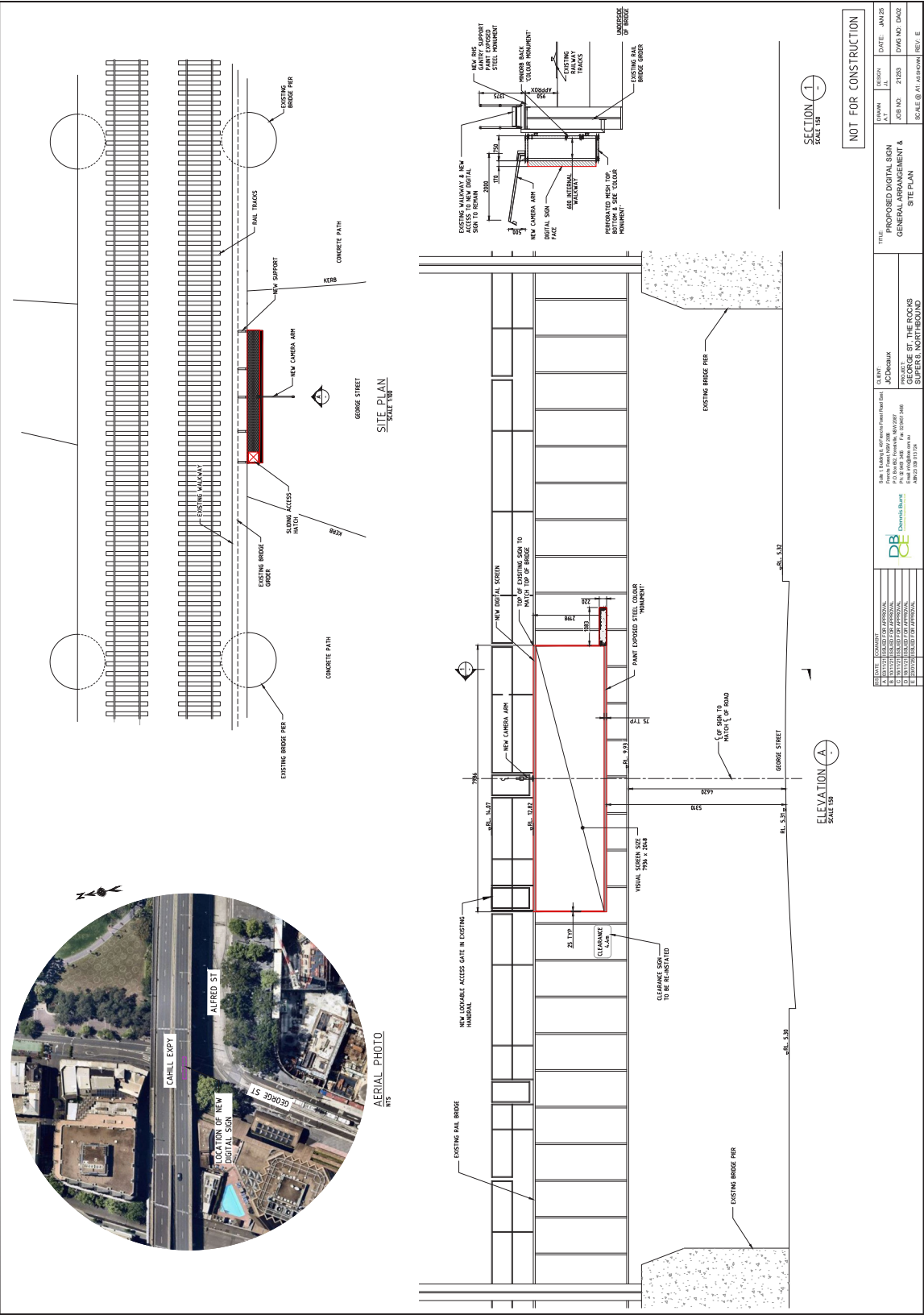
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*The digital signage is certified as long as the Conditions outlined in Appendix E are imposed in the consent.

APPENDIX A
SIGNAGE LOCATION PLAN, ELEVATIONS AND PHOTOMONTAGES



APPENDIX A
SIGNAGE LOCATION PLAN, ELEVATIONS AND PHOTOMONTAGES



APPENDIX A
SIGNAGE LOCATION PLAN, ELEVATIONS AND PHOTOMONTAGES



APPENDIX B

DIGITAL SIGNAGE SPECIFICATION

Big Screen Video		BSV Big Screen Video	
8mm Focus Specification			
Product Specifications		Product Specifications	
Catalogue No.	BSV-FOC-8	Panel Net Weight	approx. 58kg/sqm
Physical Pitch	8mm, physical	Gray Scale	16-bit color processing depth
Pixel Density	15,625 pixel/sqm	Refresh Rate	3840+ Hz
Pixel Configuration	SMD LED	Display Control	Synchronous control
Module Dimensions	256mm x 128mm	Power Supply	220V, 50Hz
Module Resolution	32 x 16 pixels	Operation Temp.	-20° ~60°
Cabinet Material	Steel	Display Dimming	Auto/Manual, 8~256 Levels
Viewing Angle	H160 Deg./V70 Deg (25 Deg above Horizontal, 45 Deg below)	Signal Transfer	Text, image, graphics animations, video
Best Viewing Distance	8+m	Power Consumption (Max. Avg.)	0.58kw/sqm; 0.21kw/sqm
Maintenance	Rear Access	Lifetime	100,000hrs
Protection Degree	IP65 Front; IP54 Rear	Luminance	7000 nits
Bringing spaces to life.		Australia – North America - NZ – SE Asia	

APPENDIX C

State Environmental Planning Policy No. 64 - Advertising and Signage

Schedule 1 Assessment criteria

(Clauses 8, 13 and 17)

1. Character of the area

- Is the proposal compatible with the existing or desired future character of the area or locality in which it is proposed to be located?
- Is the proposal consistent with a particular theme for outdoor advertising in the area or locality?

2. Special areas

- Does the proposal detract from the amenity or visual quality of any environmentally sensitive areas, heritage areas, natural or other conservation areas, open space areas, waterways, rural landscapes or residential areas?

3. Views and vistas

- Does the proposal obscure or compromise important views?
- Does the proposal dominate the skyline and reduce the quality of vistas?
- Does the proposal respect the viewing rights of other advertisers?
-

4. Streetscape, setting or landscape

- Is the scale, proportion and form of the proposal appropriate for the streetscape, setting or landscape?
- Does the proposal contribute to the visual interest of the streetscape, setting or landscape?
- Does the proposal reduce clutter by rationalising and simplifying existing advertising?
- Does the proposal screen unsightliness?
- Does the proposal protrude above buildings, structures or tree canopies in the area or locality?
- Does the proposal require ongoing vegetation management?

5. Site and building

- Is the proposal compatible with the scale, proportion and other characteristics of the site or building, or both, on which the proposed signage is to be located?
- Does the proposal respect important features of the site or building, or both?
- Does the proposal show innovation and imagination in its relationship to the site or building, or both?

6. Associated devices and logos with advertisements and advertising structures

- Have any safety devices, platforms, lighting devices or logos been designed as an integral part of the signage or structure on which it is to be displayed?

7. Illumination

- Would illumination result in unacceptable glare?
- Would illumination affect safety for pedestrians, vehicles or aircraft?
- Would illumination detract from the amenity of any residence or other form of accommodation?
- Can the intensity of the illumination be adjusted, if necessary?
- Is the illumination subject to a curfew?

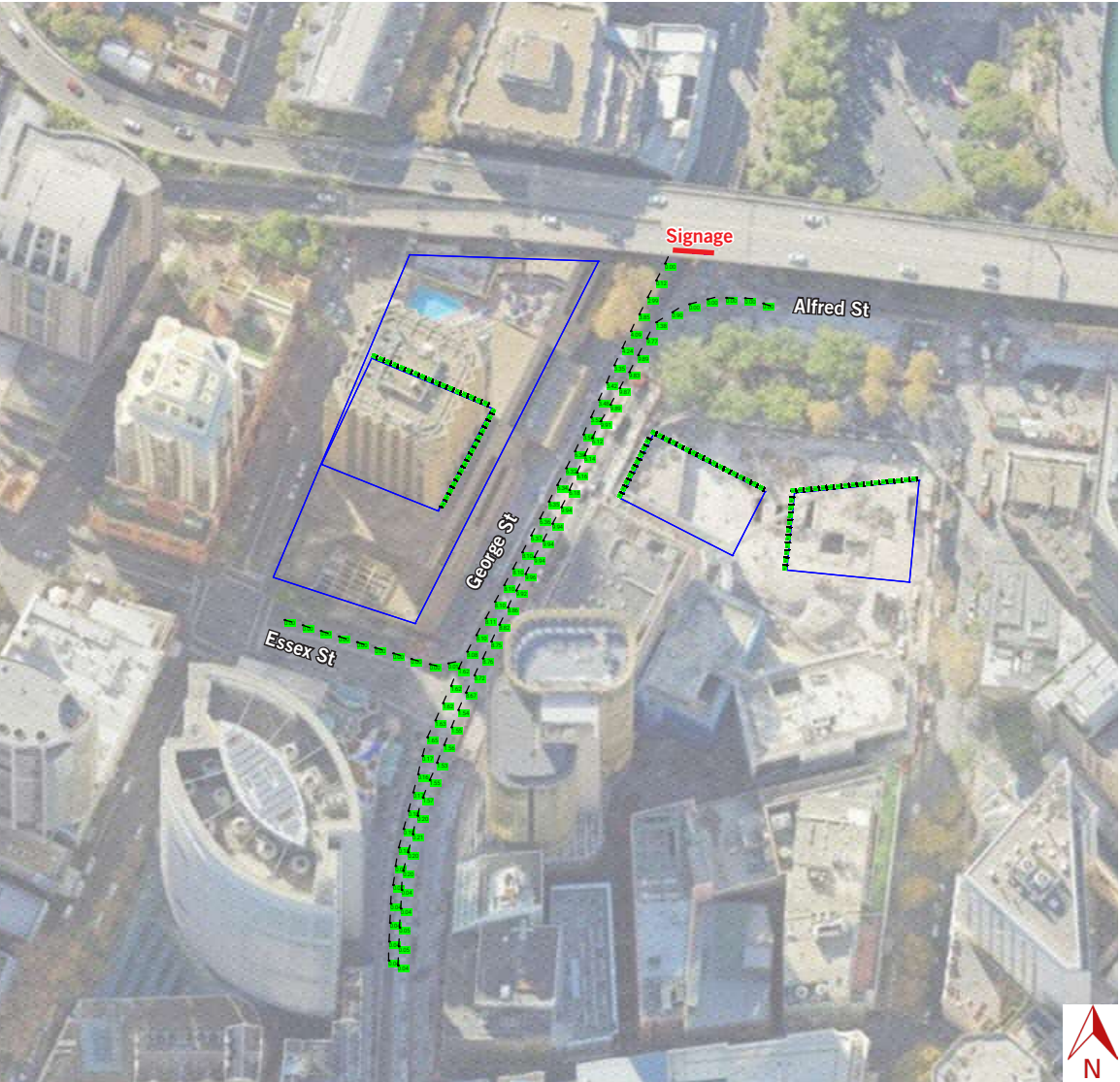
8. Safety

- Would the proposal reduce the safety for any public road?
- Would the proposal reduce the safety for pedestrians or bicyclists?
- Would the proposal reduce the safety for pedestrians, particularly children, by obscuring sightlines from public areas?

APPENDIX D

THRESHOLD INCREMENT CALCULATIONS - TWILIGHT

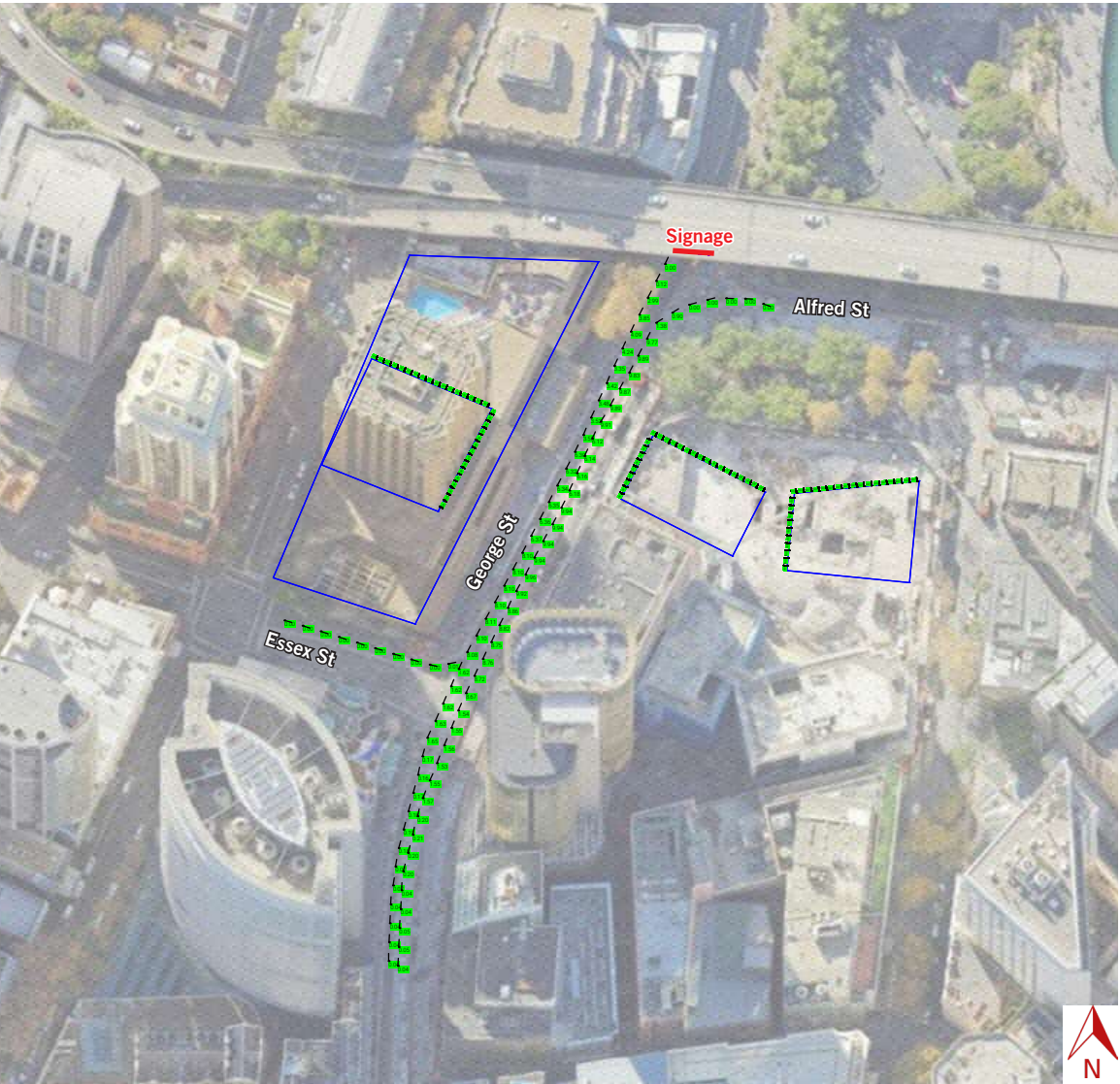
Calculation Summary			
Project: TI Twilight			
Label	CalcType	Units	Max
Essex St left to George St NB Twilight	Obtrusive - TI	%	0.02
George St Northbound Twilight	Obtrusive - TI	%	11.82
Lightrail George St Northbound Twilight	Obtrusive - TI	%	17.06



APPENDIX D

THRESHOLD INCREMENT CALCULATIONS - NIGHT TIME

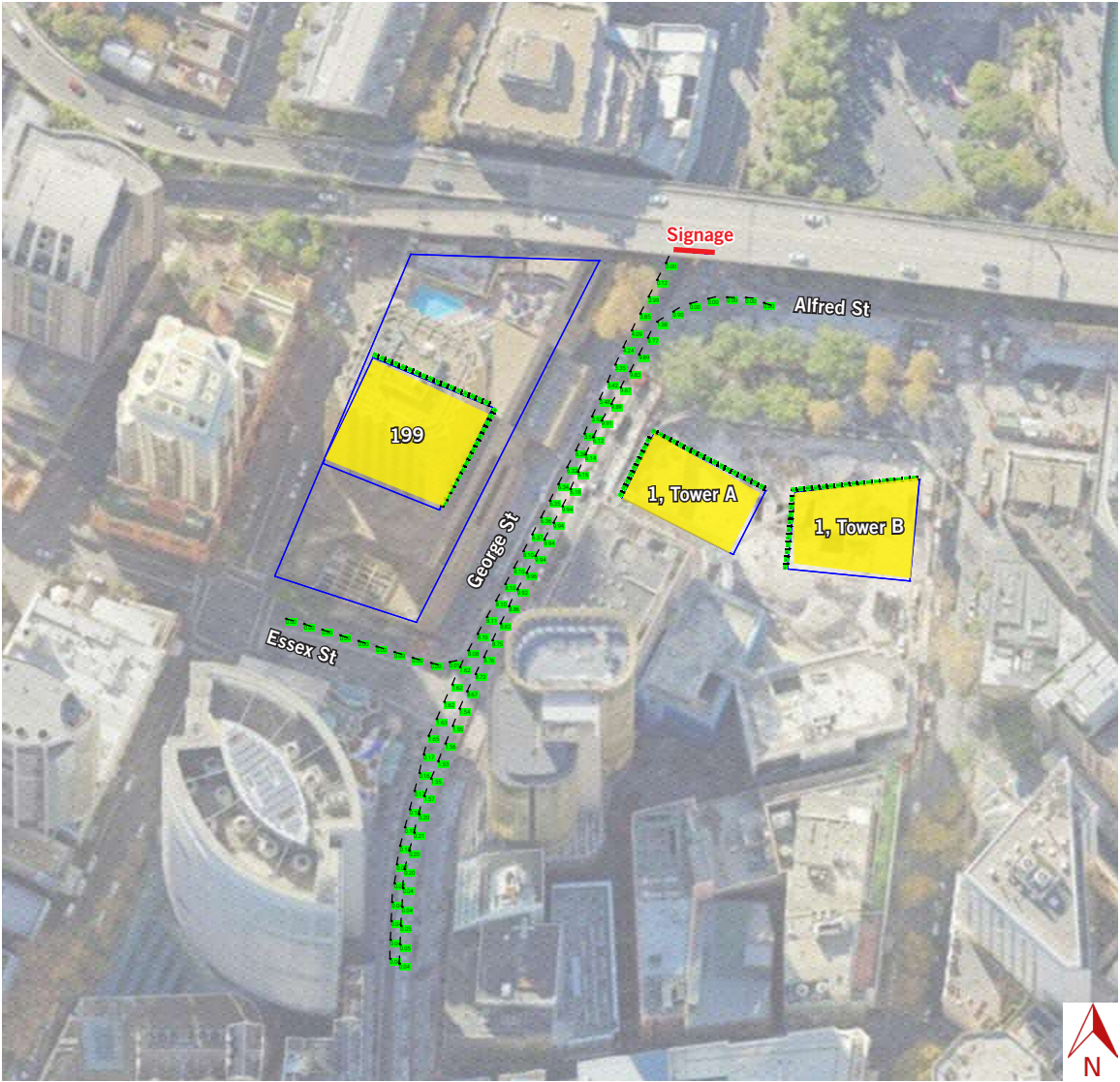
Calculation Summary			
Project: TI Nighttime			
Label	CalcType	Units	Max
Essex St left to George St NB	Obtrusive - TI	%	0.01
George St Northbound	Obtrusive - TI	%	7.00
Lightrail George St Northbound	Obtrusive - TI	%	10.03



APPENDIX D

OBTRUSIVE LIGHTING CALCULATIONS - NIGHT

Calculation Summary			
Project: A4 within 100m - Nighttime			
Label	CalcType	Units	Max
1 Alfred st_TA_Ill_Seg1	Obtrusive - Ill	Lux	0.44
1 Alfred st_TA_Ill_Seg2	Obtrusive - Ill	Lux	1.82
1 Alfred st_TB_Ill_Seg1	Obtrusive - Ill	Lux	0.35
1 Alfred st_TB_Ill_Seg2	Obtrusive - Ill	Lux	0.76
199 George St_Ill_Seg1	Obtrusive - Ill	Lux	0.45
199 George St_Ill_Seg2	Obtrusive - Ill	Lux	0.20



APPENDIX D

OBTRUSIVE LIGHTING AND THRESHOLD INCREMENT CALCULATIONS

Obtrusive Light - Compliance Report - NIGHT TIME

AS/NZS 4282:2023, A4 - High District Brightness, Curfew
Filename: 3023.5 - George St - Rev D
29/04/2025 10:55:31 AM

Illuminance

Maximum Allowable Value: 5 Lux

Calculations Tested (6):

Calculation Label	Test Results	Max. Illum.
199 George St_III_Seg1	PASS	0.45
199 George St_III_Seg2	PASS	0.20
1 Alfred st_TA_III_Seg1	PASS	0.44
1 Alfred st_TA_III_Seg2	PASS	1.82
1 Alfred st_TB_III_Seg1	PASS	0.35
1 Alfred st_TB_III_Seg2	PASS	0.76

Threshold Increment (TI)

Maximum Allowable Value: 20 %

Calculations Tested (3):

Calculation Label	Adaptation Luminance	Test Results
Essex St left to George St NB	5	PASS
George St Northbound	5	PASS
Lightrail George St Northbound	5	PASS

Obtrusive Light - Compliance Report - TWILIGHT

AS/NZS 4282:2023, A4 - High District Brightness, Curfew
Filename: 3023.5 - George St - Rev D
29/04/2025 10:57:37 AM

Threshold Increment (TI)

Maximum Allowable Value: 20 %

Calculations Tested (3):

Calculation Label	Adaptation Luminance	Test Results
George St Northbound Twilight	10	PASS
Lightrail George St Northbound Twilight	10	PASS
Essex St left to George St NB Twilight	10	PASS

APPENDIX E

Proposed lighting conditions:

1. Before the existing illuminated signage is decommissioned, a 100% white image must be installed, and with that image in place, on site luminance measurements shall be undertaken by a qualified lighting engineer to determine the average luminance of the signage. Luminance measurements shall be undertaken at night time (a minimum of 1 hour after sunset) and a report shall be provided to the Applicant with the results.

2. Once the signage is installed, it must be set to display a 100% white image and be commissioned such that the maximum average luminance of the signage during night time operation does not exceed 200 cd/m² and also does not exceed the luminance level of the existing signage determined in Condition 1. A qualified lighting engineer shall provide a report to the Applicant confirming that the signage has been commissioned correctly and that the luminance levels comply with the requirements.