REPORT

10 DANGAR STREET

WICKHAM, NSW

SSDA SOLAR REFLECTION SCREENING ANALYSIS

RWDI #2512651

31 March 2026

SUBMITTED TO

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DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Initial	12 March 2026	TYT	YCY / GEL
B	Standard Text Update	18 March 2026	TYT	YCY / GEL
C	Updated Recommendations	31 March 2026	YCY	GEL
D	Standard Text Update	31 March 2026	HK	GEL

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EXECUTIVE SUMMARY

RWDI Australia Pty Ltd. (RWDI) has been engaged by UPG Wickham Pty Ltd to investigate the impact of solar reflections emanating from the proposed development at 10 Dangar Street, Wickham, NSW ("the Project") in support of a State Significant Development Application (SSDA) (SSD-89869959).

The glare assessment was undertaken using RWDI's proprietary Eclipse simulation engine, and a conservative screening analysis was conducted to assess the frequency of reflections within 360 m of the Project, assuming a worst-case viewing direction and incorporating the existing context and nearby developments expected to be completed before the Project. At locations where potential glare on sensitive spaces (i.e., traffic intersection, pedestrian crosswalk, light rail, train line, etc) was identified, detailed analysis was conducted at one-minute intervals to determine the range of potential impacts.

The results and conclusions of the study are summarised as follows:

Visual Glare Impact on Drivers in Proposed Configuration

As with any glazed building, drivers, light rail and train drivers travelling in the vicinity of the Project were predicted to experience solar reflections emanating from it. Based on the detailed analysis results, the predicted reflections falling on this receptor:

- D6: Westbound drivers on Honeysuckle Drive

were above the veiling luminance threshold of 500 cd/m^2 in the morning in April and September, between 6:00 am and 6:15 am AEST. The predicted glare events average 3 minutes and total up to 11 minutes of potential glare per year (or less than 0.01% of daytime). These impacts are not considered unusual in an urban context. Following RWDI's review and analysis and subsequent coordination with the design team, it is understood that dense vegetation screening will be provided to mitigate these glare impacts. In order for the vegetation mitigation to be effective, a dense foliage canopy commencing at a minimum height of 2.5 m above ground level and extending to at least 5.0 m in height will be required. All remaining drivers, light rail drivers and train drivers were predicted to experience reflections below the veiling luminance threshold of 500 cd/m^2.

Visual Glare Impact on Drivers in Future Configuration

The screening analysis predicted that the future developments would reduce solar impacts on the eastern aspect of the Project (i.e. Honeysuckle Drive, Steward Avenue and Bellevue Street). The predicted glare on D6 was mitigated as the incoming and reflected sunlight were blocked by the future surroundings. No additional glare impacts were predicted for all the studied receptors as compared to the proposed configuration.

Additional details on when reflections were predicted to occur at the receptors, as well as predicted durations and intensities, can be found in Appendices B and C for the proposed and future configurations, respectively.

TABLE OF CONTENTS

LIST OF APPENDICES

1 INTRODUCTION

This SSDA Solar Reflectivity Assessment is submitted to the Department of Planning, Housing and Infrastructure (DPHI) on behalf UPG Wickham Pty. Ltd. (UPG) (the Applicant), to support a State Significant Development Application (SSDA) and concurrent Rezoning Report for the construction of a 43-storey mixed-use development at 10 Dangar Street, Wickham (the site). The site is located within the Newcastle local government area (LGA) and occupies a prominent corner position immediately north of the Newcastle Interchange.

The project has been selected by the NSW Housing Delivery Authority (HDA) as a key development to help accelerate the delivery of well-located, diverse and affordable housing in New South Wales. Commencing in early 2025, the HDA plays a coordinating role across government agencies, focusing on unlocking complex sites through strategic planning, infrastructure coordination, and streamlined assessment pathways.

Following the Applicant's expression of interest (EOI 240837), the HDA considered and recommended to the Minister for Planning and Public Spaces (the Minister) that the project be declared SSD under Section 4.36(3) of the Environmental Planning and Assessment Act 1979 (EP&A Act) on 23 June 2025. Following this recommendation, the development was declared by the Minister to be SSD pursuant to the State Significant Development Declaration Order 2025 (No 10), Part 2, Section 1(a), dated 30 June 2025.

1.1 Project Background

The site was identified under the Wickham Master Plan 2017 as a strategically significant location for increased development capacity, given its proximity to the Newcastle Interchange and its potential to support high-density, mixed-use development. The Master Plan proposed an uplift in planning controls, increasing the permissible building height from 45m to 60m, and the FSR from 5:1 to 6:1, subject to the delivery of public domain improvements, including a 3-metre southern setback adjacent to the transport interchange.

This strategic vision was subsequently reaffirmed in the Wickham Master Plan 2021 Update (PP-2021-1506) and further refined in the 2022 amendment, which supported additional incentive-based planning controls. The Community Infrastructure Incentives in Wickham Planning Proposal (PP-2022/1541), endorsed by Council in March 2022 (and subsequently approved 08 November 2022), proposed:

- An incentive FSR of 7:1 for Area E (the site),
- A maximum incentive building height of 60m, and
- Community infrastructure requirements.

In alignment with these strategies, the site has been subject to successive development consents as outlined in the Environmental Impact Statement (EIS) prepared by Beam Planning. These prior consents have been physically commenced through demolition and excavation works and establish the maximum envelope for basement structures. This SSDA will adopt and refine these commenced elements to expedite the assessment process, continue construction progress on the site, and ensure continuity with previously endorsed planning outcomes.

1.2 The Proposal

1.2.1 Rezoning Proposal

To facilitate the proposed development described in Section 3.2, a concurrent Rezoning Proposal is sought to make the following amendments to the Newcastle Local Environmental Plan 2012 (Newcastle LEP 2012) in relation to the site:

- Amend Clause 7.9 to permit a maximum building height of RL152 on the site; and,
- Amend the Clause 7.9A to permit a maximum FSR of 14.4:1 on the site.

1.2.2 State Significant Development Application

The proposed amendments to the Newcastle LEP 2012, as outlined above, will facilitate the following development, proposed via a concurrent SSDA. Specifically, the proposed works sought under the SSDA include:

- Construction of a 43-storey (+ plant) mixed-use tower, comprising:
  - 245 residential apartments
  - 99 co-living units
  - Ground floor retail premises, to all three street frontages
  - A hotel component within the podium
  - Basement car parking
- Associated landscaping and public domain improvements, including the provision of a pedestrian through-site link that runs east/west adjacent to the Newcastle Interchange.

It is noted that the project will commit to providing 15% of the residential GFA as affordable housing for a minimum of 15 years, to be managed by a registered Community Housing Provider (CHP).

The proposed SSDA will seek consent for the use of basement structures and enabling works approved under DA2018/01197 (as modified).

For a detailed description of the proposed development, refer to the EIS prepared by Beam Planning, and the Architectural Drawings prepared by SJB Architecture.

1.3 The Site

The site is located at 10 Dangar Street, Wickham, within the Newcastle LGA. The site benefits from triple street frontages, with a primary street frontage of approximately 64m to Dangar Street, and secondary street frontages of approximately 61m to Hannell Street and 50m to Charles Street.

The surrounding locality comprises a diverse mix of land uses including residential, commercial, and light industrial uses, reflecting the area's ongoing transition. The site's frontage to Hannell Street, a major arterial road, supports high levels of connectivity to the broader metropolitan area. The site is located immediately north of the Newcastle Interchange, providing bus, rail and light rail services. Strategically, the site sits at the intersection of the Newcastle West End, Wickham, and Honeysuckle precincts, positioning it to support the city's transition to a higher-density, mixed use metropolitan centre.

The site is currently vacant following demolition works approved under DA2018/01197 (as modified).

Figure 1 illustrates the location of the site.

Figure 1: Aerial Photo of the Project (Credit: provided by client)

1.4 Relevant SEARs/Rezoning Requirements

This SSDA Solar Reflectivity Assessment has been prepared to address the following relevant Secretary's Environmental Assessment Requirements (SEARs) and Guidance for Concurrent Rezoning Report: SSD Housing issued for the project set out in the table below.

Table 1: SEARs Compliance Table for SSD-89869959

Requirement	Response / Location in Report
SEARs Requirement	
7. Environment Amenity Assess amenity impacts on the surrounding locality, including solar access, visual privacy, view loss and view sharing, as well as wind, lighting and **reflectivity** impacts. A high level of environmental amenity for any surrounding residential or other sensitive land uses must be demonstrated.	Section 3

This analysis was conducted in two parts. First, a 'screening' simulation estimated the frequency of occurrence of reflections which may cause glare for a broad area around the development. This was done in order to understand the potential for visual impacts on people due to the reflections. Note that the screening analysis intentionally assumed a very conservative direction in which the viewer is facing (horizontal, but directly towards the building).

Since reflections were predicted on sensitive spaces (i.e., traffic intersection, pedestrian crosswalk, light rail, train line, etc), the 'detailed' analysis phase was undertaken. This investigated the potential for glare at select locations in greater temporal detail and also included the effect of the direction viewers are likely to be facing.

The analysis was conducted for two configurations:

i. **Proposed:** Results are presented in Sections 2 & 3, and
ii. **Future:** Results are presented in Section 4.

2 BACKGROUND

2.1 Understanding Urban Reflections

While a common occurrence, solar reflections from buildings can lead to numerous visual issues, including:

- Impair the vision of motorists and others who cannot easily look away from the source;
- Cause nuisance to pedestrians or occupants of nearby buildings; and
- Create undesirable patterns of light throughout the urban fabric.

However, the level of impact of these issues on people will be influenced by many other factors that are unique to the reflecting surface(s), the individual(s)/object(s) exposed to reflections and the environment around them. In a complex urban space, these factors are often difficult to reasonably predict, if they can be predicted at all.

As such, it must be acknowledged that there is an element of uncertainty and subjectivity to any reflection analysis, particularly when it comes to visual glare which is inherently a subjective experience and lacks a universally agreed upon quantifiable definition. The metric and threshold used by RWDI (detailed in Appendix A) are based on industry standard approaches in Australia, but as noted above, are subject to a degree of uncertainty/subjectivity. This means that the possibility of reflection impacts from a building can never be completely ruled out through simulation.

RWDI's approach is to instead provide a suitably conservative analysis of the potential effects of reflected sunlight and contextualise how the Project's reflections compare to other projects studied by RWDI, and if any predicted impacts would be considered atypical given the Project's context. Regulation and enforcement of performance requirements is the responsibility of others.

2.2 Methodology

The analysis was conducted using RWDI's in-house proprietary *Eclipse* simulation engine. The first phase was a 'Screening Analysis' which predicted the maximum intensity and frequency of occurrence of reflections from the Project for every hour of a full calendar year. These values were computed on 'presentation surfaces' located approximately 1.5 m above grade-level and approximately 2.5m above grade-level for the train tracks, within approximately 360 m radius from the Project. Note that the screening analysis intentionally assumed a very conservative direction in which the viewer is facing (horizontal, but directly towards the building). In the Proposed Configuration, the analysis included the existing surrounding context and other ongoing developments that are expected to finish construction prior to the Project completion (i.e., 924 Hunter Street and 854 Hunter Street), whereas the other proposed developments that are currently under assessment or approved (i.e. not yet under construction) were excluded.

Should the potential for glare exist on roadways or other sensitive spaces (i.e., traffic intersection, pedestrian crosswalk, light rail, train line, etc), multiple 'receptor points' are selected to undergo the second 'Detailed Analysis' phase. This analysis works similarly to the screening simulation, except glare is tested at one-minute increments and a direction of view is explicitly prescribed. This yielded detailed predictions at specific locations of when reflections can occur, how long they can occur for and the locations of problematic glare sources. The detailed study also provides the level of reflectivity reduction required to comply with local criteria.

As reflections were predicted on sensitive spaces, the detailed assessment was undertaken for this Project. Note that the detailed analysis was not intended to be an exhaustive investigation of all locations where reflections are possible. It was instead intended to provide an understanding of the range of possible reflection characteristics from the Project.

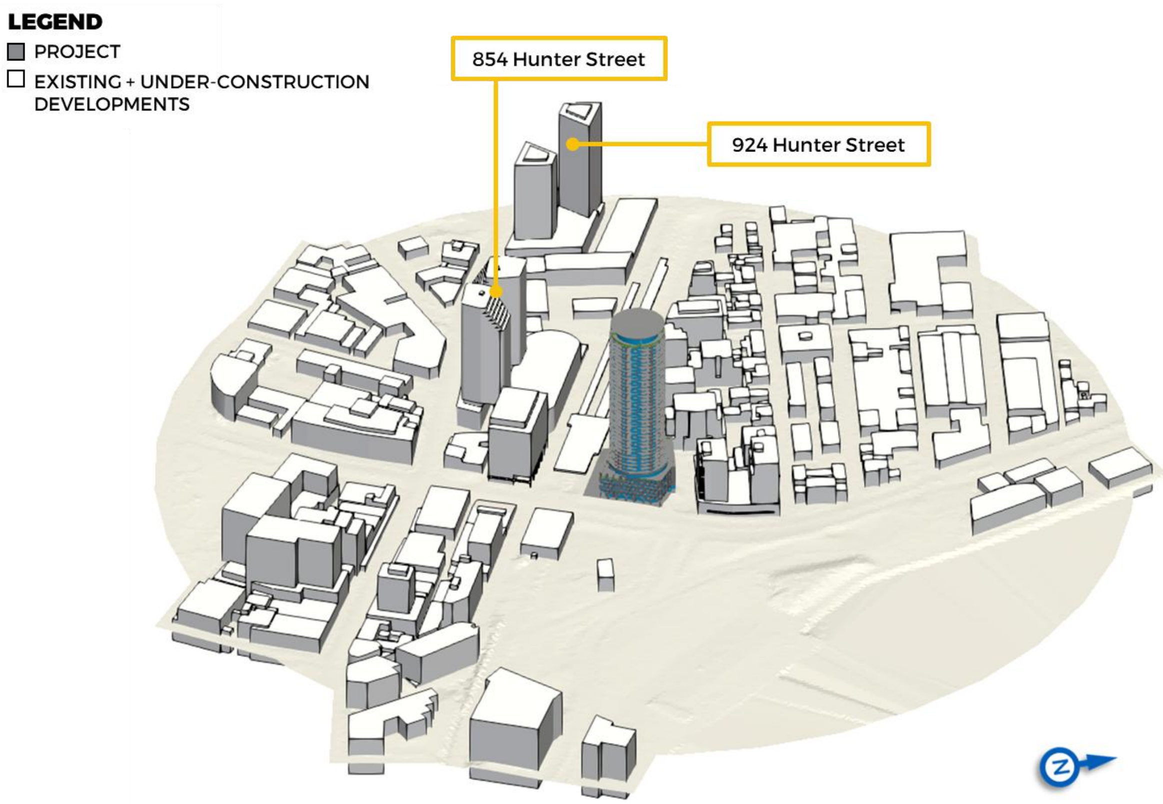

Figure 2: 3D Computer Model of the Project and Surrounding Context for Proposed Configuration

2.3 Assumptions and Limitations

2.3.1 Meteorological Data

This analysis used 'clear sky' solar data computed at the location of Newcastle Nobbys Signal Station using the method promulgated by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE). This approach used mathematical algorithms to derive solar intensity at a given location, ignoring the localised effects of cloud cover. This provides a 'worst case' scenario showing the full extent of when and where glare could ever occur.

2.3.2 Radiation Model

RWDI's analysis is only applicable to the visual impacts of solar radiation (i.e. visible wavelengths only) on people, including drivers in the vicinity of the development. It did not consider the impact of the building related to any other forms of radiation, such as thermal energy, cellular telephone signals, RADAR arrays, etc.

2.3.3 Study and Surrounds Models

The analysis was conducted based on 3D model and 2D drawings of the Project provided by UPG Wickham Pty Ltd to RWDI up to 27 January 2026.

The surrounding model for the Proposed Configuration was generated based on publicly available data and previous RWDI projects in the area. This analysis included the existing surrounding context and other ongoing developments that are expected to finish construction prior to the Project completion (i.e., 924 Hunter Street and 854 Hunter Street) whereas the other proposed developments that are currently under assessment or approved (i.e. not yet under construction) were excluded.

As described above, only relevant developments were included in the assessment as this would be conservative on the reflections falling on the public realm. All data sources were cross-checked against LiDAR data published by the NSW Department of Finance, Services, and Innovation. This dataset was also used to generate the ground surface and has a stated vertical and horizontal accuracy of 0.3m and 0.8m, respectively (both at a 95% confidence interval).

Potential reductions of solar reflections due to the presence of vegetation or other non-architectural obstructions were not included, nor were reflections from other buildings, per standard industry practice. Light that has reflected off several surfaces was assumed to have a negligible impact. As such, only a single reflection from the Project was included in the analysis.

This analysis assumed that all reflective elements are in their as-designed condition, (i.e. clean, free from damage, degradation, distortion, etc.) and that the building envelopes of all buildings are complete and uncompromised (i.e. any elements of the walls/roofs that are not designed to be exposed to sun, are shielded).

The results presented in this report are highly dependent on both the form and materiality of the Project. Should there be any changes to the design, it is recommended that RWDI be contacted and requested to review any potential effects on the findings of this report.

2.3.4 Facade Material Reflectance

All glazing including glass balustrades has been assumed to have a nominal 20% reflectivity for visible light approaching perpendicular to the surface, which increases with the angle of incidence. While the nominal reflectivity values of the IGUs are noted above, the reflectivity of glass will increase exponentially as light strikes it at increasingly glancing angles. This effect was included in the simulations. We have also omitted the railings in the model for conservatism.

RWDI also notes that only the glazing panels specified through the 3D model and 2D drawings received up to 27 January 2026 have been studied, and all other buildings/facade elements are understood to have negligible specular reflectivity and, therefore, were assumed to be non-reflective.

The locations of the reflective materials on the facades are illustrated in Figure 3.

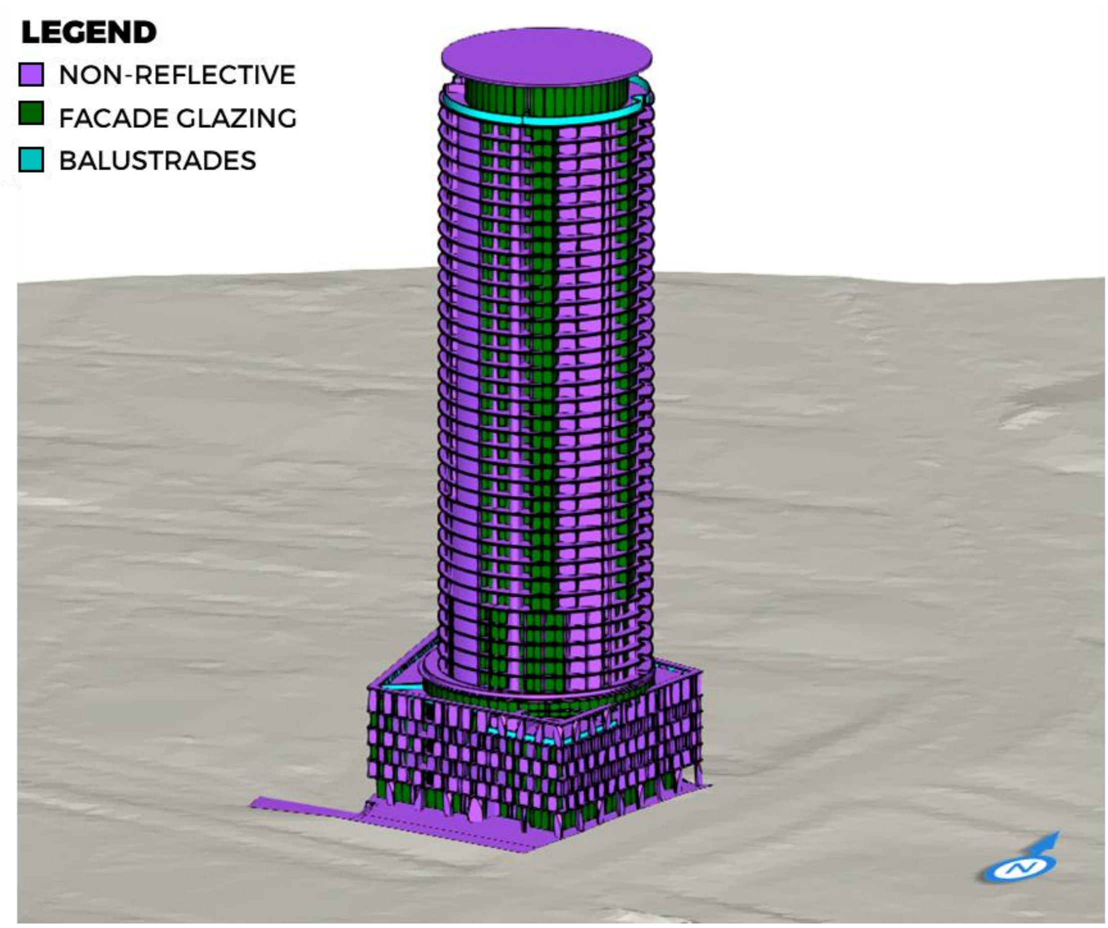

Figure 3: Locations of Reflective Building Elements (Surrounding Context removed for Clarity)

2.3.5 Human Factors

This analysis also assumes reasonable and responsible behaviour on the part of people in the vicinity of the development. A reasonable and responsible person would not purposely look towards a bright reflection, purposely prolong their exposure to reflected light, or otherwise intentionally try to cause discomfort/harm to themselves or others and/or damage to the property.

3 RESULTS AND DISCUSSION

3.1 Screening-Level Analysis

3.1.1 Results

This section presents the screening results pertaining to the solar impacts of the Project on the surrounding urban area in the Proposed Configuration.

The **Percentage of Time Above the Veiling Luminance Threshold** plot (Figure) identifies the percentage of day-time hours where the veiling luminance was predicted to exceed the 500 cd/m² limit proposed by Hassall[1]. *Note that, as a conservative assumption, at each location, it is assumed that the viewer is always facing horizontally towards the source of any reflection that can reach them.*

The veiling luminance-based results present predictions for a 62-year-old viewer. This represents approximately the 80th percentile age of the residents of New South Wales, which means that veiling luminance will be lower than these predictions for 80% of the population.

It is important to understand that the figures do not show a specific moment in time, but rather present aggregated reflection predictions for an entire year.

In order to attain a complete understanding of the impact that reflections may have on people, other factors must be considered, including the duration of the reflections, when they occur and where the viewer is looking. The following plot serves to illustrate the general characteristics of reflections from the Project and informed the locations of the receptor points selected for the detailed phase of work, which analysed these factors in greater detail.

[1]*Hassall, D., "Reflectivity: Dealing with Rogue Solar Reflections" University of New South Wales, 1991.*

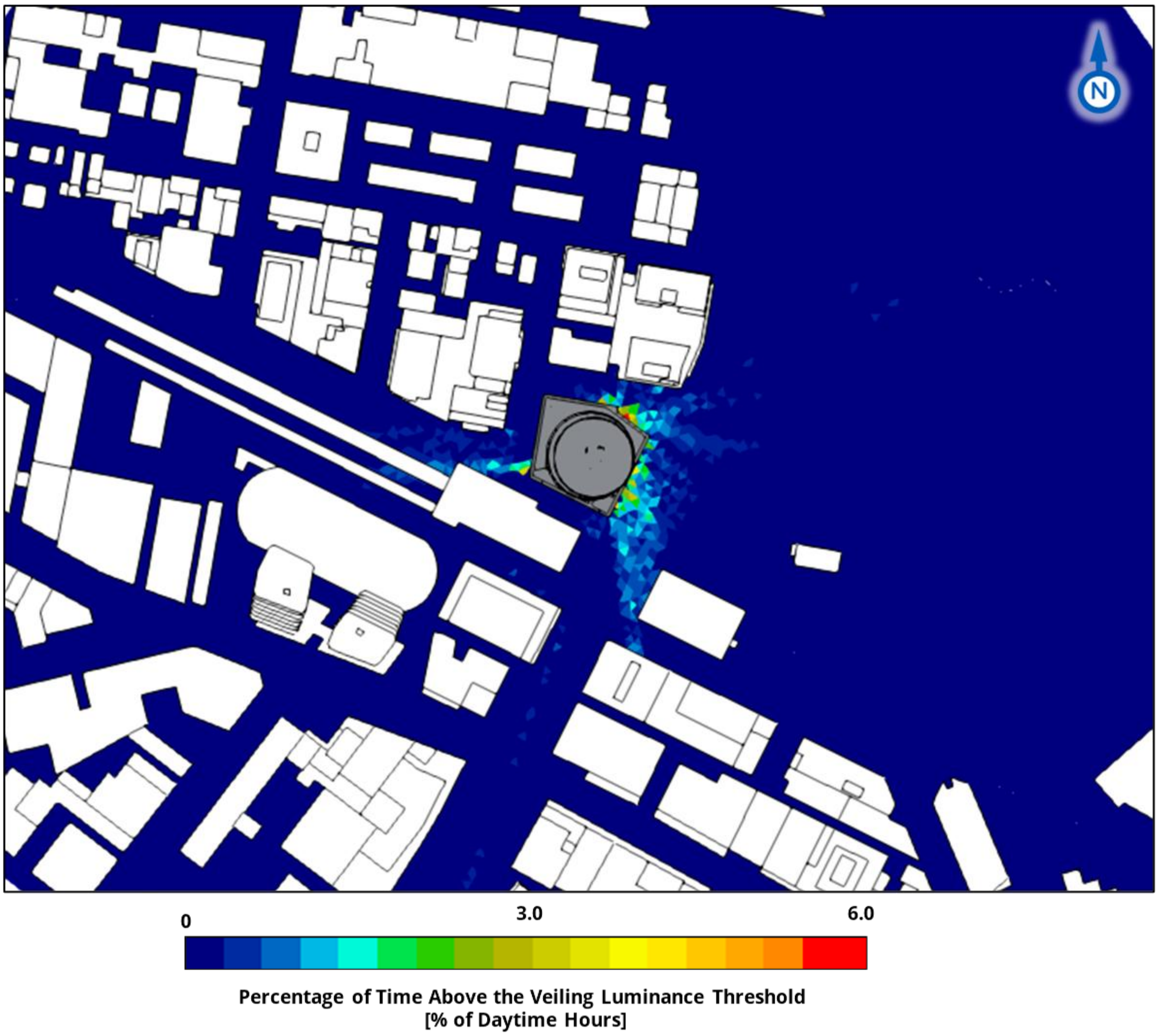

Figure 4: Frequency (% of Daylit Hours) Where Veiling Luminance Above Threshold were Predicted at Pedestrian Height for an 80th Percentile Resident (Age 62) in the Proposed Configuration

3.2 Detailed Analysis

3.2.1 Receptor Locations

Based on the findings of the Screening Analysis, 11 representative points were selected for the Detailed Analysis. These points are described in Table 2 and illustrated in Figure 5. All points are located at a height of 1.5 m above local grade, except for those on the train tracks, which were 2.5 m above grade-level.

Table 2: Receptor Descriptions

Receptor Number	Receptor Description
D1	Northbound drivers on Steward Ave
D2	Northbound drivers on Steward Ave, waiting in front of the tram line
D3	Westbound drivers exiting Beresford St
D4	Northbound drivers on Hannell St
D5	Northbound drivers on Honeysuckle Dr, turning left onto Hannell St
D6	Westbound drivers on Honeysuckle Dr
D7	Southbound drivers on Charles St, turning left onto Dangar St
D8	Southbound drivers at the intersection between Hannell St and Honeysuckle Dr
D9	Westbound Newcastle Light Rail drivers approaching Newcastle Interchange station
D10-D11	Eastbound train drivers approaching Newcastle Interchange station

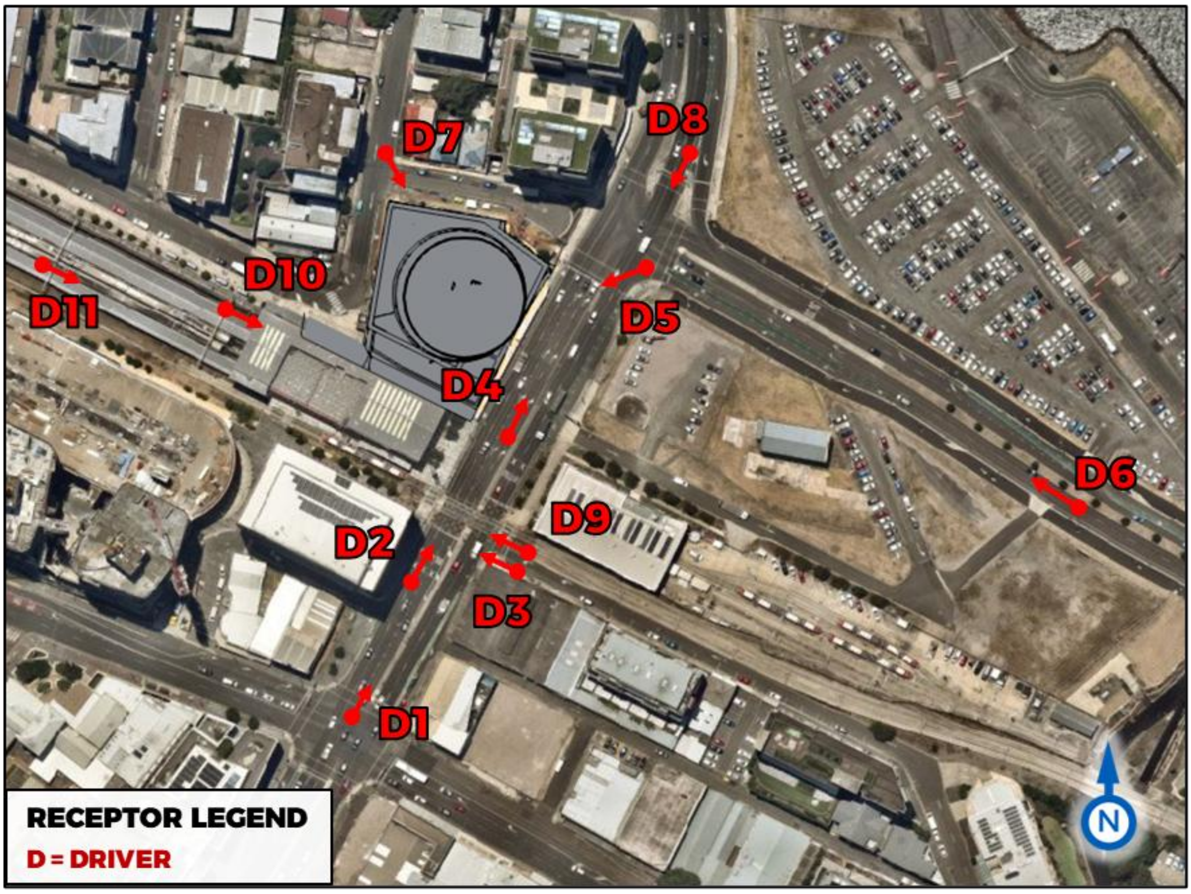

Figure 5: Driver Receptor Locations (Map Underlay Credit: NearMap). The Project in dark grey.

3.2.2 Presentation of Results

Table 3 below summarises the level of visual impact predicted at each of the studied receptors based on the simulation results in the Proposed Configuration. The minute-by-minute results for each point are presented as 'Annual Reflection Impact Diagrams' which distil an entire year's worth of data into a single diagram. The diagrams for each receptor, as well as an explanation for how to read the diagrams, are provided in Appendix B.

Additional details of RWDI's criteria are found in Appendix A.

Table 3: Summary of Overall Predicted Impacts on Receptors

Receptor Number	Receptor Type	Max Veiling Luminance (cd/m^2)	Duration / Total Number of Minutes with High Impact Reflection (Veiling Luminance > 500 cd/m^2)	% of High Impacts Where the Sun Is Also Visible
D1	Driver	59	N/A	N/A
D2	Driver	35	N/A	N/A
D3	Driver	29	N/A	N/A
D4	Driver	131	N/A	N/A
D5	Driver	62	N/A	N/A
D6	Driver	[1]863	Average Duration: **3 minutes** Total: **11 minutes/year** (less than 0.01% of the daytime)	0%
D7	Driver	307	N/A	N/A
D8	Driver	34	N/A	N/A
D9	Light Rail Driver	28	N/A	N/A
D10	Train Driver	242	N/A	N/A
D11	Train Driver	68	N/A	N/A

[1]This predicted glare events at this receptor were very infrequent (<0.01% of the daytime) and not unusual in an urban context. It should be noted that this assessment conservatively assumes that the driver is looking towards the building during the window of time when glare is possible, and that there are clear skies for all daytime hours, ignored the effect of sunglasses, and ignore the effect of any obstructions to the reflected light (such as landscaping, the driver's car body, other vehicles, etc.).

3.3 Overall Observations and Conclusions

1. Like any contemporary building, the reflective surfaces of the Project are naturally causing solar reflections in the surrounding area.
2. The screening analysis predicted a low potential for glare, even with its highly conservative assumption that the viewer would always be looking horizontally towards the source of the reflection. The most frequent reflections were predicted to be confined within the area immediately east of the Project along Hannell Street, where glare was predicted to occur up to 3.3% of the daytime hours annually. It is noted that the results are based on a conservative viewing assumption; this frequency of glare potential would only be possible if drivers were unsafely looking towards the source of the reflection (e.g., at the Project) rather than the road ahead. Accordingly, this level and extent of predicted glare is considered acceptable and does not pose a safety concern.
3. The detailed analysis, which accounted for more realistic view directions and operated at one-minute increments, predicted that the westbound driver on Honeysuckle Drive (D6) has a risk of glare during morning times in April and September. That said, the frequency at which glare was possible was predicted to be very low (less than 0.01% of the daytime hours annually) and of short duration (on average, it lasted 3 minutes), which is extremely rare and not unusual in an urban context.
4. The highlighted areas in Figure 6 illustrate the sources of glare. Following subsequent coordination with the design team, it is understood that significant and dense vegetation is proposed in front of these areas to mitigate the potential glare impacts. In order to the vegetation to be effective, it is recommended that the vegetation should comprise a dense foliage canopy commencing at a minimum height of 2.5 m above ground level (i.e., combined bole height + planter box height is 2.5 m) and extend to a crown height of at least 5.0m.
5. All remaining studied drivers (D1-D5 and D7-D8), light rail driver (D9), and train driver (D10-D11) receptors have the potential to be exposed to reflections emanating from the Project. However, none of these reflections was predicted to exceed the veiling luminance threshold of 500 cd/m^2.
6. For further details, refer to the visual impact diagrams for all receptors (D1-D11) as shown in Appendix B.
7. Given the safety risks associated with glare impacts on drivers, RWDI's analysis is intentionally conservative. It assumed clear skies for all daytime hours and ignored the effects of any landscaping, the use of sunglasses, as well as obstructions to reflected light due to the car body.
8. The results presented in this report are highly dependent on both the form and materiality of the Project. Should there be any changes to the design, it is recommended that RWDI be contacted and requested to review any potential effects on the findings of this report.
9. Final 100% frozen drawings were issued to RWDI on 30 March 2026 prior to the issuance of this report. The updated design indicates minor changes to the ground-level glazing, including a transition from a planar glazing system to a convex glazing configuration at the hotel lobby. Based on a review of the updated design, as the glazing remains in the same location, the potential glare impacts on D6 are expected to persist. Additional glazing elements were also identified within upper-level balcony areas; however, due to the associated setbacks, these changes are not anticipated to significantly alter the conclusions of the current analysis. Further detailed simulations will be required to quantify the glare impacts due to these changes.

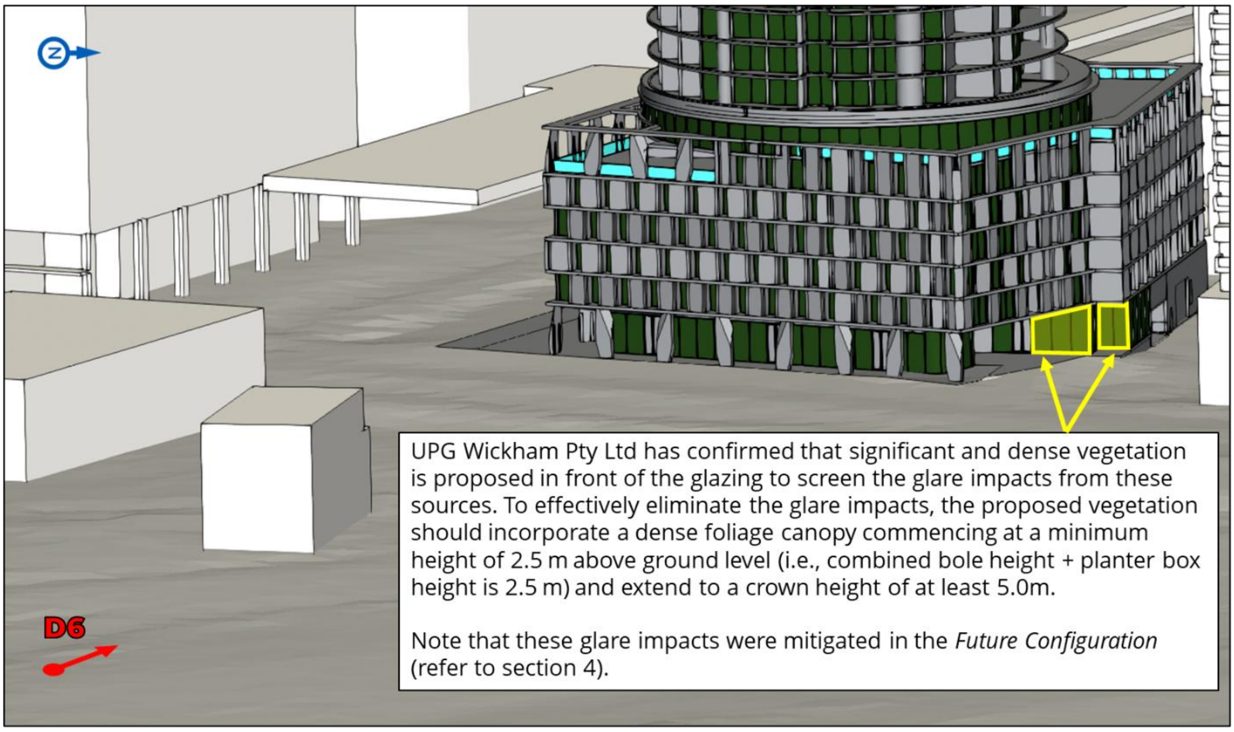

Figure 6: Markup of Facade Locations for Glare Source at Receptor D6

4 CUMULATIVE IMPACT ASSESSMENT (CIA)

As outlined in the Department of Planning, Housing and Infrastructure's "Cumulative Impact Assessment Guidelines for State Significant Project" project level cumulative impact assessment (CIA) is considered for the impacts of the proposed 10 Dangar Street development in combination with other reasonably foreseeable and wind significant future projects within the vicinity (i.e. 815 Hunter Street and Honeysuckle HQ Development). This CIA is also proportionate to the scale and significance of the Project and the considered future projects (see Figure 7).

As undertaken for the Project in the Proposed Configuration, both the screening and detailed simulations were repeated for the surrounding context of the future (i.e. Future Configuration) to understand the solar reflectivity impacts of the Project on the surrounding urban area.

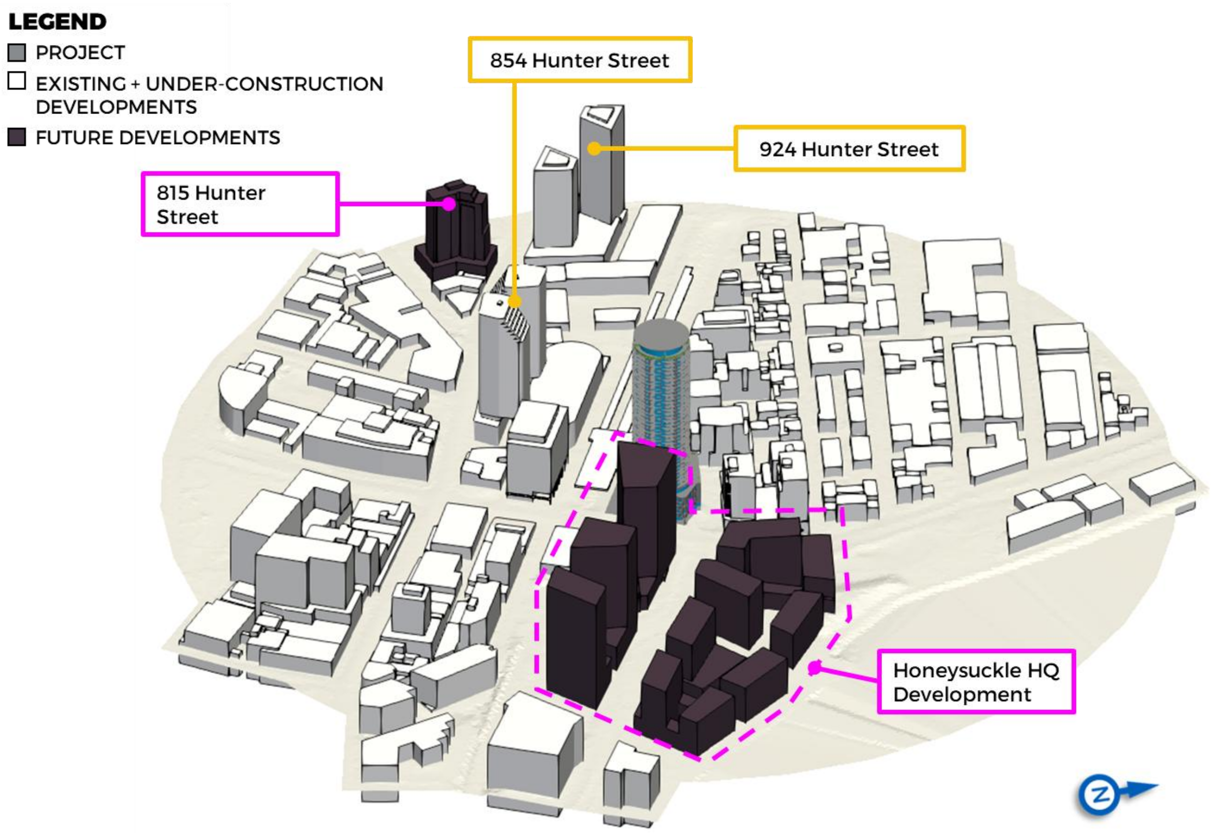

Figure 7: 3D Computer Model of the Project and Surrounding Context for Future Configuration

4.1 Screening-Level Analysis

- The screening analysis predicted that the future developments located east of the Project (i.e. Honeysuckle HQ Development) helped with blocking incoming and reflected morning sunlight, eventually reducing the frequency of reflections exceeding the veiling luminance threshold on the eastern aspect of the Project (i.e. Honeysuckle Drive, Steward Avenue and Bellevue Street).
- On the other hand, the future development at 815 Hunter Street has no meaningful effect on reducing the frequency of reflections exceeding the veiling luminance threshold on the public realm due to its far distance from the Project.

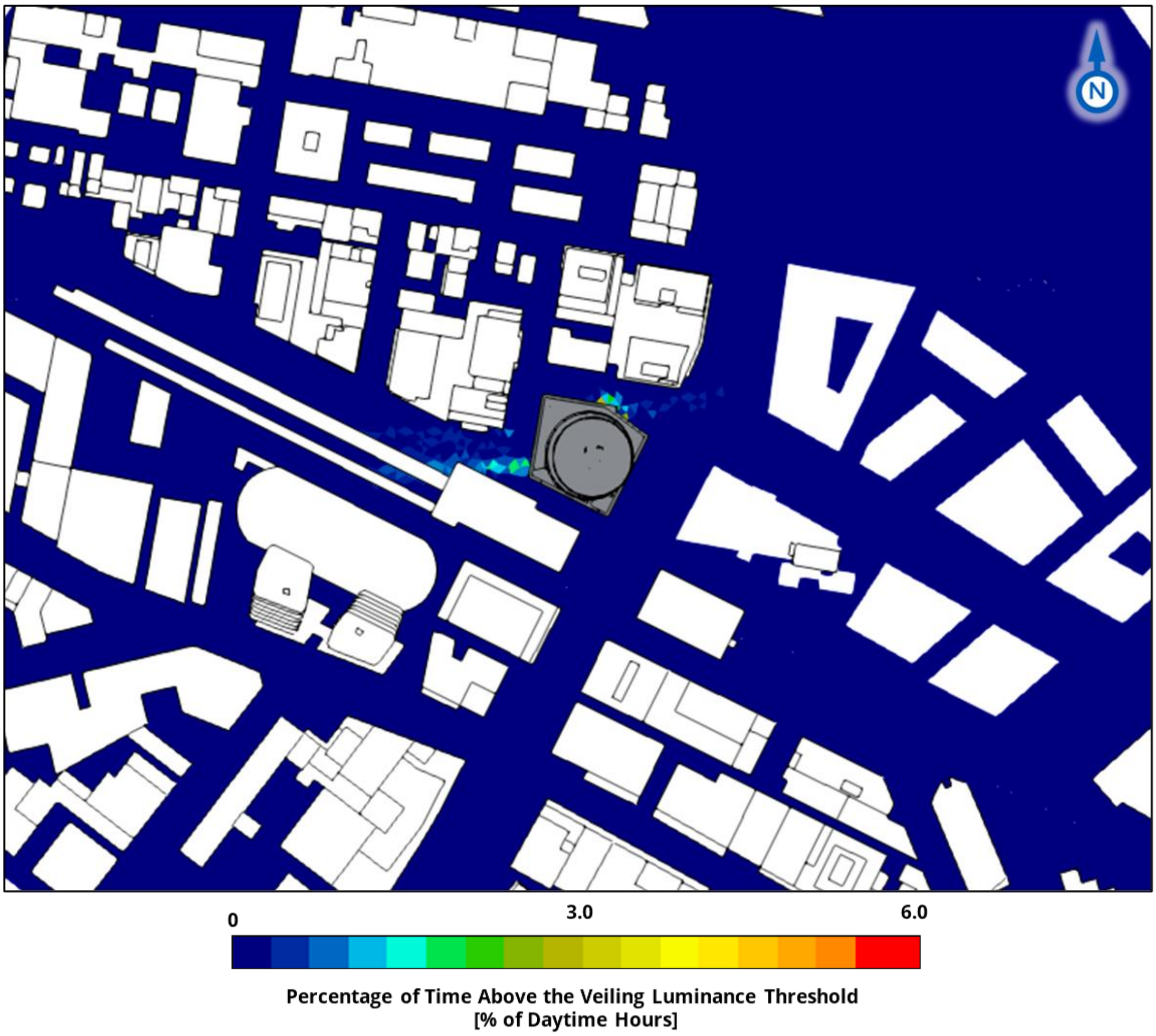

Figure 8: Frequency (% of Daylit Hours) Where Veiling Luminance Above Threshold were Predicted at Pedestrian Height for an 80th Percentile Resident (Age 62) in Future Configuration

4.2 Detailed Analysis

- RWDI had also conducted a detailed analysis by repeating the simulations for the same 11 receptor points per Table 2, as the screening analysis did not identify additional potential for glare at the roadway/light rail line/train track locations around the Project.
- All studied drivers (D1-D8), light rail driver (D9), and train driver (D10-D11) receptors have the potential to be exposed to reflections emanating from the Project. However, these reflections were predicted to remain below the veiling luminance threshold of 500 cd/m^2.
- Furthermore, no reflections were predicted to land on receptor D6 (which will be mitigated through the proposed landscaping on the ground plane at the north-east corner of the development discussed in Section 3.3) as the incoming sunlight was blocked by Honeysuckle HQ Development.
- For further details, refer to the visual impact diagrams for all receptors (D1-D11) as shown in Appendix C.

Table 4: Summary of Overall Predicted Impacts on Receptors in CIA

Receptor Number	Receptor Type	Max Veiling Luminance (cd/m^2)	Duration / Total Number of Minutes with High Impact Reflection (Veiling Luminance > 500 cd/m^2)	% of High Impacts Where the Sun Is Also Visible
D1	Driver	5	N/A	N/A
D2	Driver	0	N/A	N/A
D3	Driver	29	N/A	N/A
D4	Driver	131	N/A	N/A
D5	Driver	62	N/A	N/A
D6	Driver	0	N/A	N/A
D7	Driver	307	N/A	N/A
D8	Driver	34	N/A	N/A
D9	Light Rail Driver	28	N/A	N/A
D10	Train Driver	242	N/A	N/A
D11	Train Driver	68	N/A	N/A

5 GENERAL STATEMENT OF LIMITATIONS

This report, entitled "*10 Dangar Street, Wickham – SSDA Solar Reflection Screening Analysis",* dated *31 March 2026*, was prepared by RWDI Australia Pty Ltd ("RWDI") for UPG Wickham Pty Ltd ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein ("Project"). The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared.

Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client during the final stages of the project to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilise the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.

APPENDIX A

RWDI REFLECTION CRITERIA

Visual Glare

RWDI has extensive experience in the analysis and assessment of the impacts of sunlight and solar energy reflected from buildings[1].

This assessment was conducted in response to the requirements outlined in the Secretary's Environmental Assessment Requirements (SEARs) under Environmental Amenity as reproduced below:

"Assess amenity impacts on the surrounding locality, including solar access, visual privacy, view loss and view sharing, as well as wind, lighting and reflectivity impacts. A high level of environmental amenity for any surrounding residential or other sensitive land uses must be demonstrated."

However, the SEARs does not provide a description around what constitutes a reflectivity impact or what would be considered a dangerous level of glare from the Project.

In light of the context described above, we have adopted the typical Australian criteria put forth by Hassall[2], which defines glare as occurring when the veiling luminance of a reflection exceeds 500 cd/m^2.

Veiling luminance was computed using the CIE General Disability Glare Equation[3]. This equation is a more robust formulation of the classical Stiles-Holladay glare equation that accounts for the effects of age and eye colour when predicting veiling luminance. This formulation remains valid for light sources between 0.1° and 100° away from the direction of view.

RWDI conservatively assumed a light-blue eye colour (pigmentation factor of 1.2) and an observer age of 62 years old for this work. Based on the most recent Australian Census, this age represents approximately the 80th percentile age for the residents of New South Wales. This means that in reality, veiling luminance would be lower than these predictions for 80% of the population.

It should be noted that the 500 cd/m^2 limit assumes an adaptation luminance corresponding to a dawn or dusk time frame and may be overly conservative during brighter parts of the day.

References

1. Danks, R., Good, J., & Sinclair, R., “Assessing reflected sunlight from building facades: A literature review and proposed criteria.” *Building and Environment*, 103, 193-202, 2016.

2. Hassall, D., “Reflectivity: Dealing with Rogue Solar Reflections” *University of New South Wales, 1991*.

3. Vos, J., et al. "CIE equations for disability glare." *CIE TC Report CIE 146* (2002): 2002.

APPENDIX B

ANNUAL REFLECTION IMPACT DIAGRAMS – PROPOSED CONFIGURATION

Presentation of Results

Results are illustrated using “annual impact diagrams”. These plots condense the minute-by-minute annual dataset into a single image. The vertical axis represents the time of the day, and the horizontal axis indicates the day of the year. A sample of such a diagram is shown in Figure B1.

Please note that the referenced times are in local standard time. When Daylight Saving Time is observed, the time should be shifted by an hour when appropriate.

The colours on this plot indicate when all reflections falling on a specific point were predicted and if the predicted veiling luminance exceeds the disability glare threshold (500 cd/m²) for an 80th percentile resident (62 years old) for New South Wales. Hatching (i.e., dark green areas) indicates when the sun would be within 30° of a motorist’s direction of view.

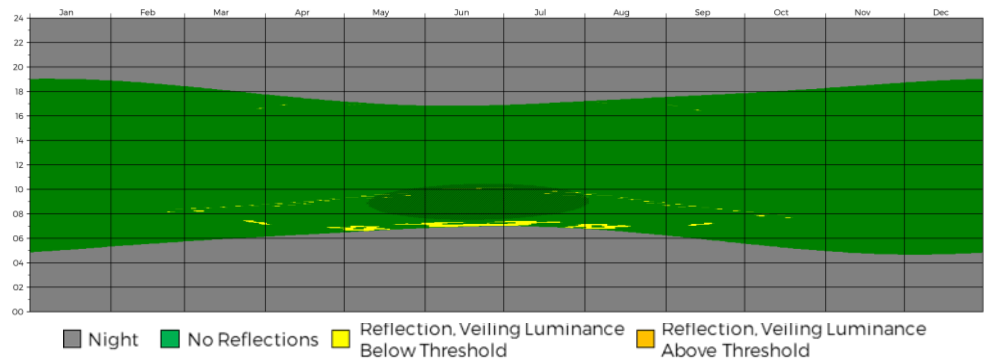

Figure B1: Annual Reflection Impact Diagram for Driver Receptor D4

APPENDIX B: ANNUAL REFLECTION IMPACT DIAGRAMS

Driver Receptor D1

Receptor D1 was chosen to assess the visual impact associated with solar reflections affecting northbound drivers on Steward Avenue.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

5:15 am to 8:00 am AEST

- October through March
- June through early July

2:30 pm to 3:15 pm AEST

- November through January

The maximum veiling luminance predicted was 59 cd/m².

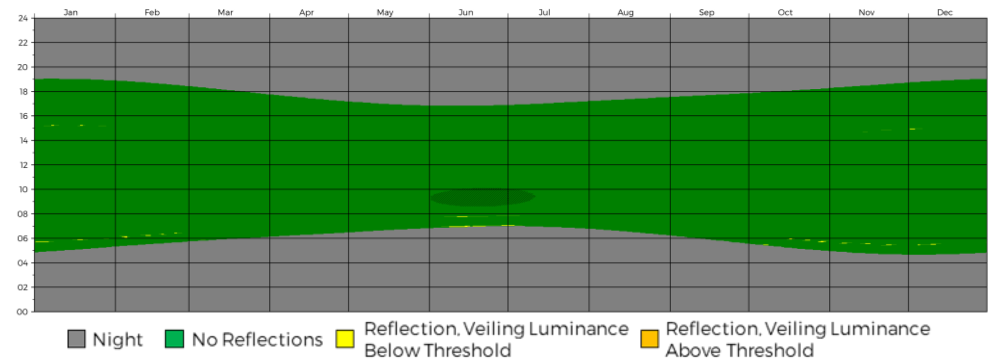

Figure B2: Annual Reflection Impact Diagram for Driver Receptor D1

Driver Receptor D2

Receptor D2 was chosen to assess the visual impact associated with solar reflections affecting northbound drivers on Steward Avenue, waiting in front of the light rail line.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

5:15 am to 7:15 am AEST

- October through early March
- Late May through July

The maximum veiling luminance predicted was 35 cd/m².

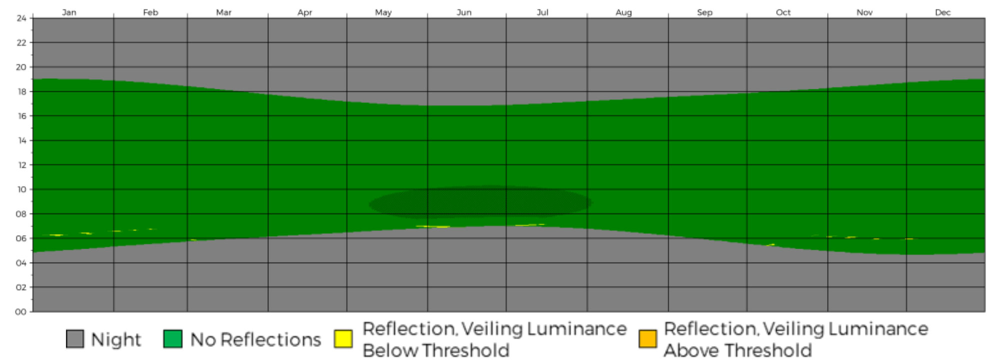

Figure B3: Annual Reflection Impact Diagram for Driver Receptor D2

Driver Receptor D3

Receptor D3 was chosen to assess the visual impact associated with solar reflections affecting westbound drivers exiting Beresford Street.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

6:00 am to 8:45 am AEST

- Throughout the year

4:00 pm to 6:00 pm AEST

- February through May
- Mid-July through early November

The maximum veiling luminance predicted was 29 cd/m².

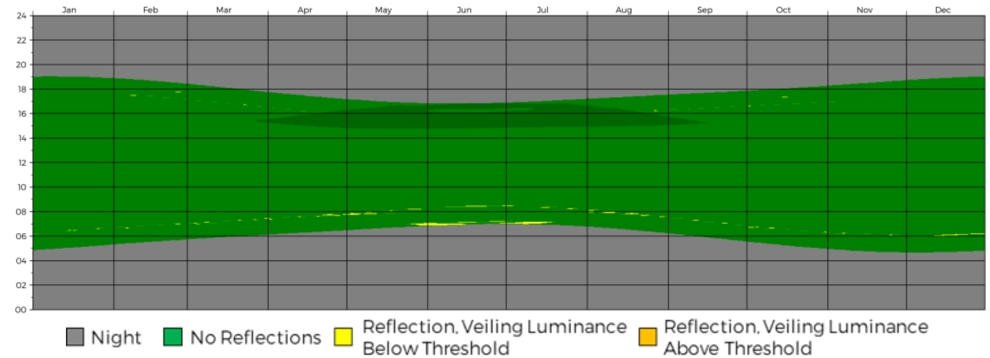

Figure B4: Annual Reflection Impact Diagram for Driver Receptor D3

Driver Receptor D4

Receptor D4 was chosen to assess the visual impact associated with solar reflections affecting northbound drivers on Hannell Street.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

6:30 am to 10:15 am AEST

- Mid-February through October

4:15 pm to 5:15 pm AEST

- Late March through May
- Early August through September

The maximum veiling luminance predicted was 131 cd/m².

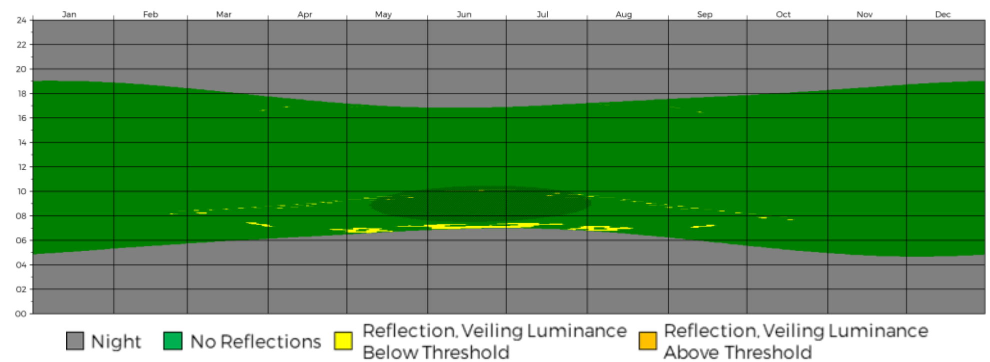

Figure B5: Annual Reflection Impact Diagram for Driver Receptor D4

Driver Receptor D5

Receptor D5 was chosen to assess the visual impact associated with solar reflections affecting northbound drivers on Honeysuckle Drive, turning left onto Hannell Street.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

5:15 am to 8:15 am AEST

- Late January through early April
- September through mid-November

The maximum veiling luminance predicted was 62 cd/m².

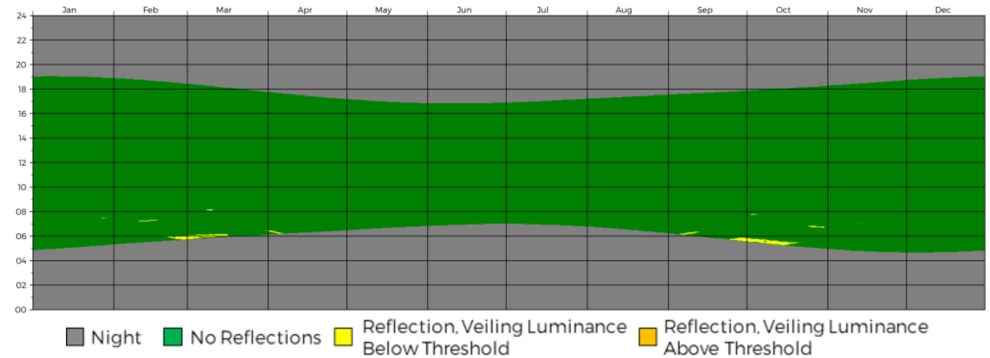

Figure B6: Annual Reflection Impact Diagram for Driver Receptor D5

Driver Receptor D6

Receptor D6 was chosen to assess the visual impact associated with solar reflections affecting westbound drivers on Honeysuckle Drive.

The simulations indicated that intermittent reflections may fall on this point between **5:00 am to 1:30 pm AEST** throughout the year.

Very brief instances where veiling luminance exceeded 500 cd/m² (maximum predicted value was 863 cd/m²) were predicted in April and September. On average these reflections lasted 3 minutes and were predicted to occur between 6:00 am and 6:15 am AEST, totalling 11 minutes per year of potential glare, or less than 0.01% of the daytime.

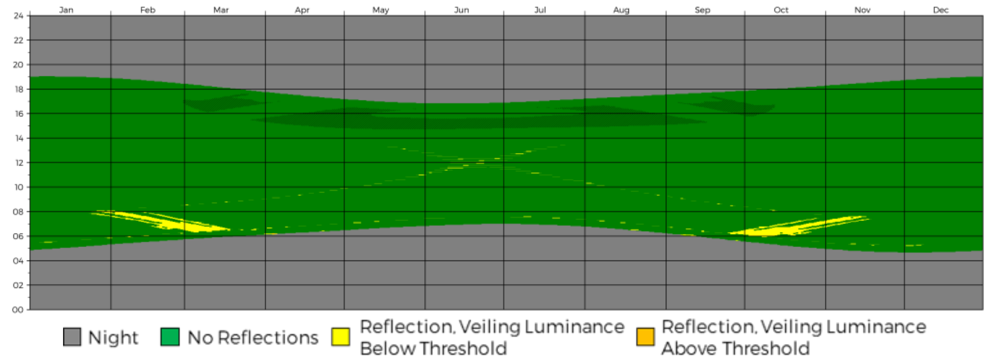

Figure B7: Annual Reflection Impact Diagram for Driver Receptor D6

Driver Receptor D7

Receptor D7 was chosen to assess the visual impact associated with solar reflections affecting southbound drivers on Charles Street, turning left onto Dangar Street.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

6:15 am to 6:45 am AEST

- April
- Mid-August through early September

9:00 am to 11:00 am AEST

- Mid-March through September

The maximum veiling luminance predicted was 307 cd/m².

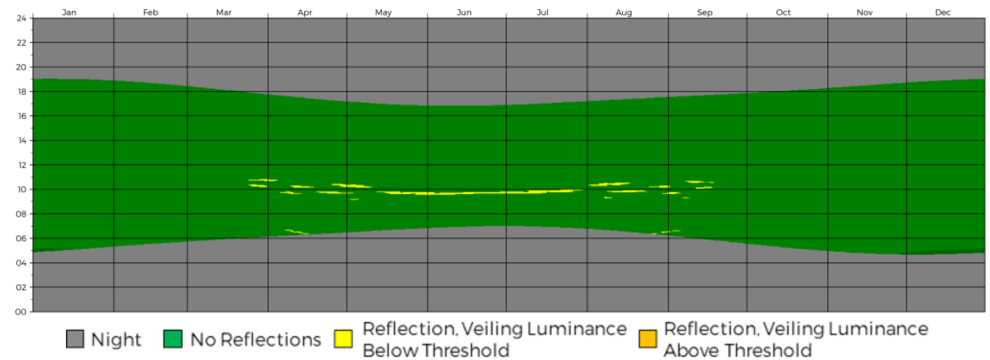

Figure B8: Annual Reflection Impact Diagram for Driver Receptor D7

Driver Receptor D8

Receptor D8 was chosen to assess the visual impact associated with solar reflections affecting southbound drivers at the intersection between Hannell Street and Honeysuckle Drive.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

4:30 am to 7:15 am AEST

- December through February
- Late-May through July
- October

9:30 am to 11:30 am AEST

- October through mid-March

3:30 pm to 4:00 pm AEST

- Mid-May, late July

The maximum veiling luminance predicted was 34 cd/m².

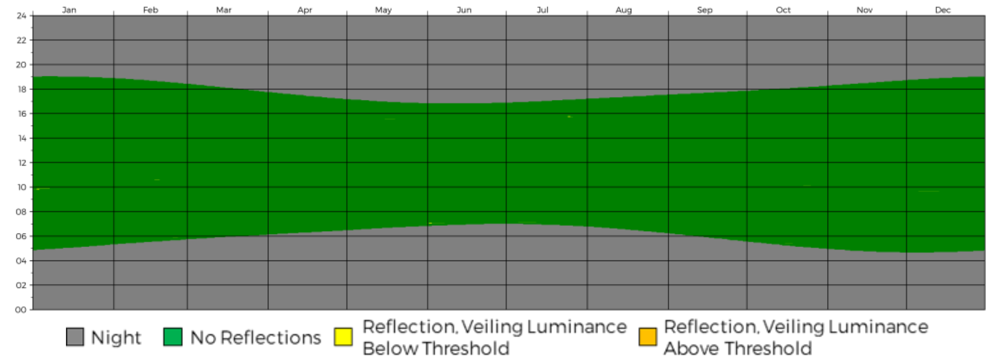

Figure B9: Annual Reflection Impact Diagram for Driver Receptor D8

Driver Receptor D9

Receptor D9 was chosen to assess the visual impact associated with solar reflections affecting westbound Newcastle Light Rail drivers approaching Newcastle Interchange Station.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

6:00 am to 8:45 am AEST

- Throughout the year

4:15 pm to 5:45 pm AEST

- February through mid-April
- September through early November

The maximum veiling luminance predicted was 28 cd/m².

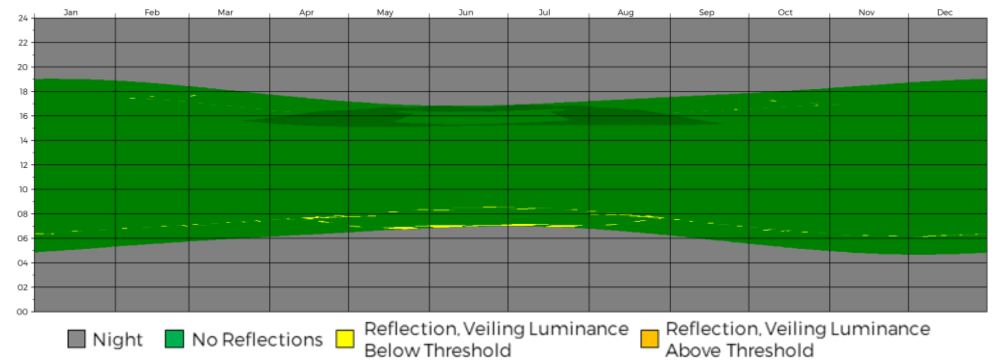

Figure B10: Annual Reflection Impact Diagram for Driver Receptor D9

Driver Receptor D10

Receptor D10 was chosen to assess the visual impact associated with solar reflections affecting eastbound train drivers approaching Newcastle Interchange Station.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

3:00 pm to 5:30 pm AEST

- Mid-March through mid-May
- August through September

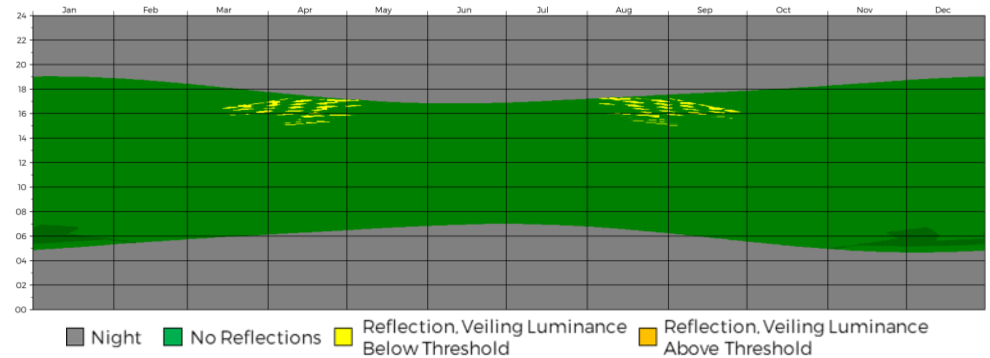

Figure B11: Annual Reflection Impact Diagram for Driver Receptor D10

The maximum veiling luminance predicted was 242 cd/m².

Driver Receptor D11

Receptor D11 was chosen to assess the visual impact associated with solar reflections affecting eastbound train drivers approaching Newcastle Interchange Station.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

11:15 am to 2:30 pm AEST

- March through April
- Late August through mid-October

2:45 pm to 5:30 pm AEST

- January through April
- Mid-August through November

The maximum veiling luminance predicted was 68 cd/m².

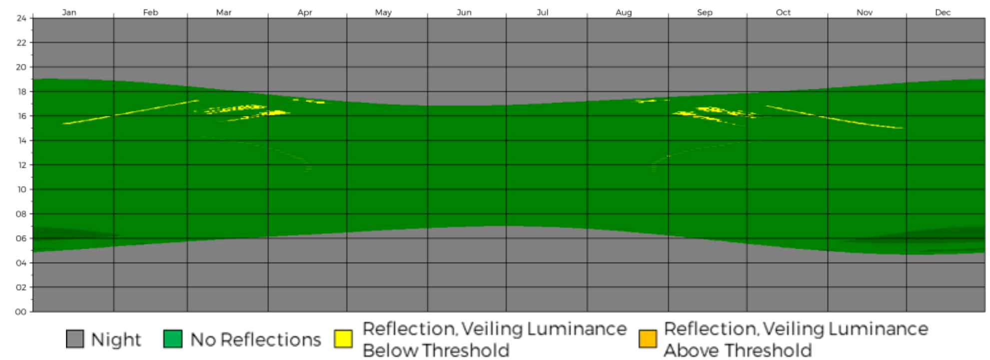

Figure B12: Annual Reflection Impact Diagram for Driver Receptor D11

APPENDIX C

ANNUAL REFLECTION IMPACT DIAGRAMS – FUTURE CONFIGURATION

Driver Receptor D1

Receptor D1 was chosen to assess the visual impact associated with solar reflections affecting northbound drivers on Steward Avenue.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

2:30 pm to 3:15 pm AEST

- Mid-November through January

The maximum veiling luminance predicted was 5 cd/m².

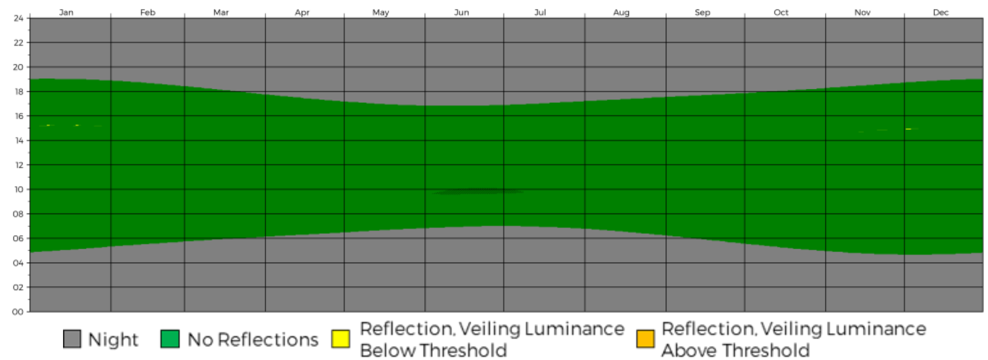

Figure C1: Annual Reflection Impact Diagram for Driver Receptor D1

Driver Receptor D2

Receptor D2 was chosen to assess the visual impact associated with solar reflections affecting northbound drivers on Steward Avenue, waiting in front of the light rail line.

The simulations indicated that no reflections emanating from the Project may fall on this point.

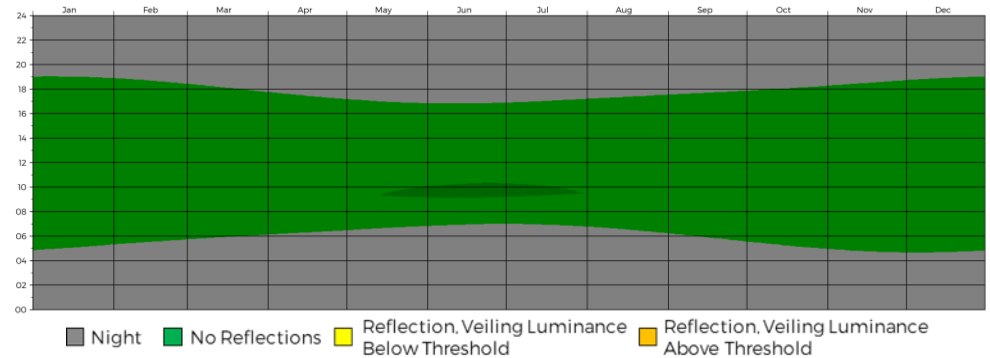

Figure C2: Annual Reflection Impact Diagram for Driver Receptor D2

Driver Receptor D3

Receptor D3 was chosen to assess the visual impact associated with solar reflections affecting westbound drivers exiting Beresford Street.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

7:00 am to 8:45 am AEST

- Mid-March through September

4:00 pm to 6:00 pm AEST

- February through May
- Mid-July through early November

The maximum veiling luminance predicted was 29 cd/m².

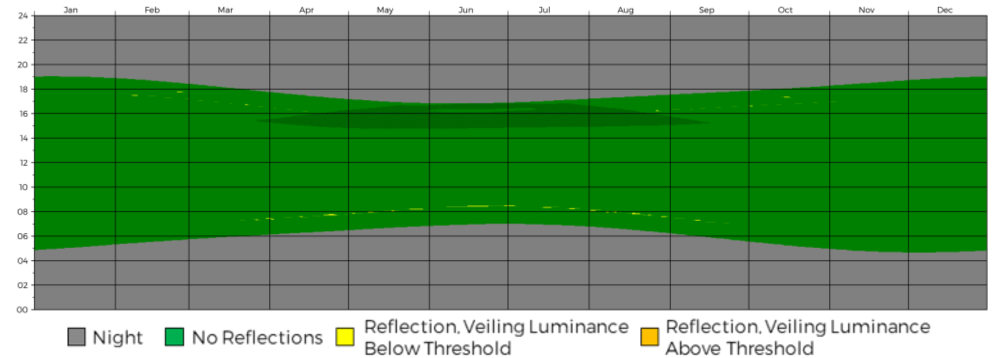

Figure C3: Annual Reflection Impact Diagram for Driver Receptor D3

Driver Receptor D4

Receptor D4 was chosen to assess the visual impact associated with solar reflections affecting northbound drivers on Hannell Street.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

7:45 am to 10:15 am AEST

- Late February through October

4:15 pm to 5:15 pm AEST

- Late March through May
- Early August through September

The maximum veiling luminance predicted was 131 cd/m².

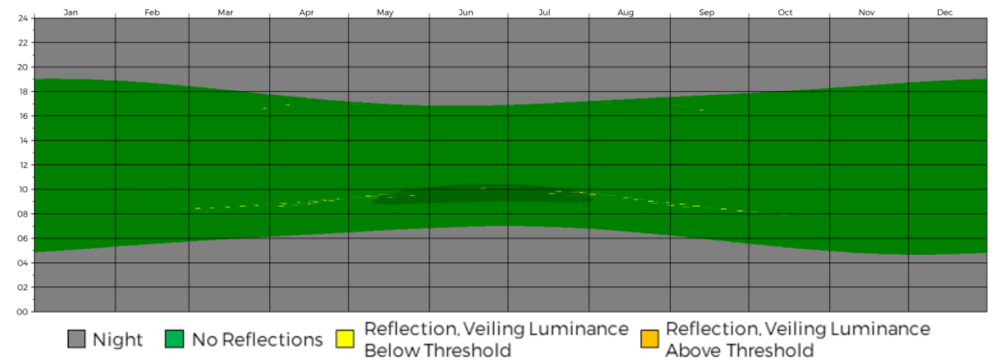

Figure C4: Annual Reflection Impact Diagram for Driver Receptor D4

Driver Receptor D5

Receptor D5 was chosen to assess the visual impact associated with solar reflections affecting northbound drivers on Honeysuckle Drive, turning left onto Hannell Street.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

6:30 am to 8:15 am AEST

- Late January through mid-March
- October through mid-November

The maximum veiling luminance predicted was 62 cd/m².

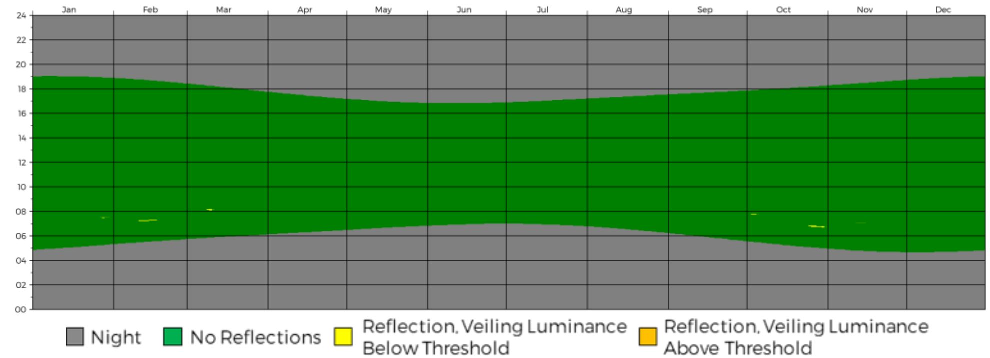

Figure C5: Annual Reflection Impact Diagram for Driver Receptor D5

Driver Receptor D6

Receptor D6 was chosen to assess the visual impact associated with solar reflections affecting westbound drivers on Honeysuckle Drive.

The simulations indicated that no reflections emanating from the Project may fall on this point.

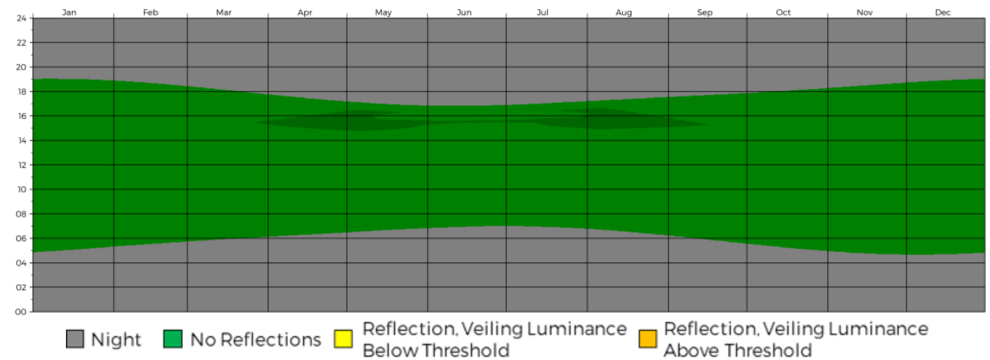

Figure C6: Annual Reflection Impact Diagram for Driver Receptor D6

Driver Receptor D7

Receptor D7 was chosen to assess the visual impact associated with solar reflections affecting southbound drivers on Charles Street, turning left onto Dangar Street.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

9:00 am to 11:00 am AEST

- Mid-March through September

The maximum veiling luminance predicted was 307 cd/m².

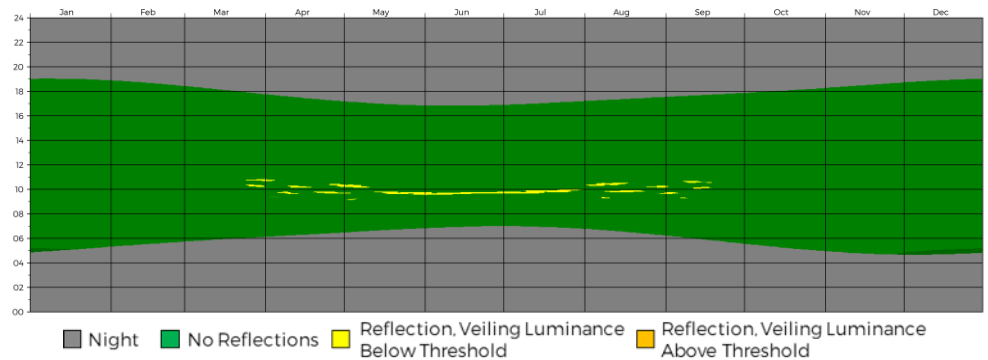

Figure C7: Annual Reflection Impact Diagram for Driver Receptor D7

Driver Receptor D8

Receptor D8 was chosen to assess the visual impact associated with solar reflections affecting southbound drivers at the intersection between Hannell Street and Honeysuckle Drive.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

9:30 am to 11:30 am AEST

- October through mid-March

3:30 pm to 4:00 pm AEST

- Mid-May, late July

The maximum veiling luminance predicted was 34 cd/m².

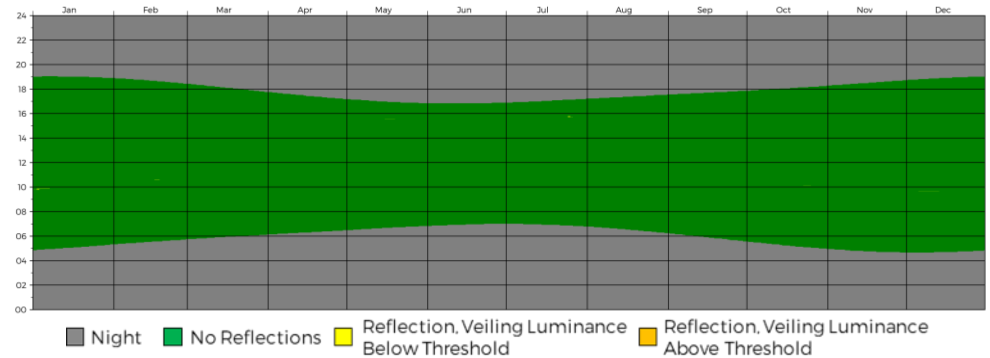

Figure C8: Annual Reflection Impact Diagram for Driver Receptor D8

Driver Receptor D9

Receptor D9 was chosen to assess the visual impact associated with solar reflections affecting westbound Newcastle Light Rail drivers approaching Newcastle Interchange Station.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

7:00 am to 8:45 am AEST

- Mid-March through September

4:15 pm to 5:45 pm AEST

- February through mid-April
- September through early November

The maximum veiling luminance predicted was 28 cd/m².

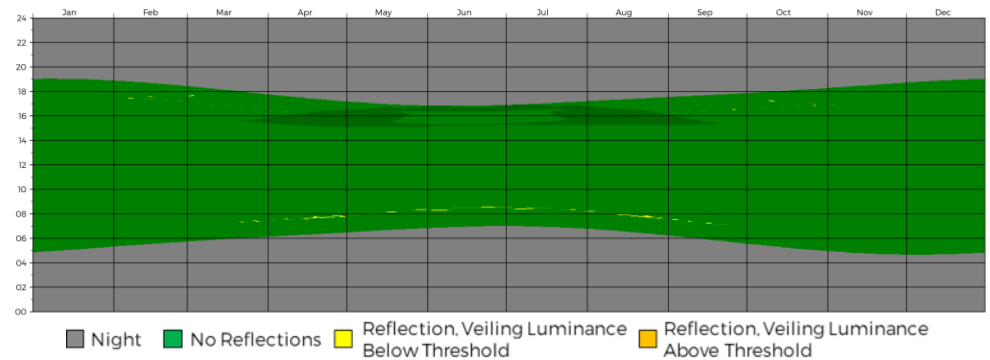

Figure C9: Annual Reflection Impact Diagram for Driver Receptor D9

Driver Receptor D10

Receptor D10 was chosen to assess the visual impact associated with solar reflections affecting eastbound train drivers approaching Newcastle Interchange Station.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

3:00 pm to 5:30 pm AEST

- Mid-March through mid-May
- August through September

The maximum veiling luminance predicted was 242 cd/m².

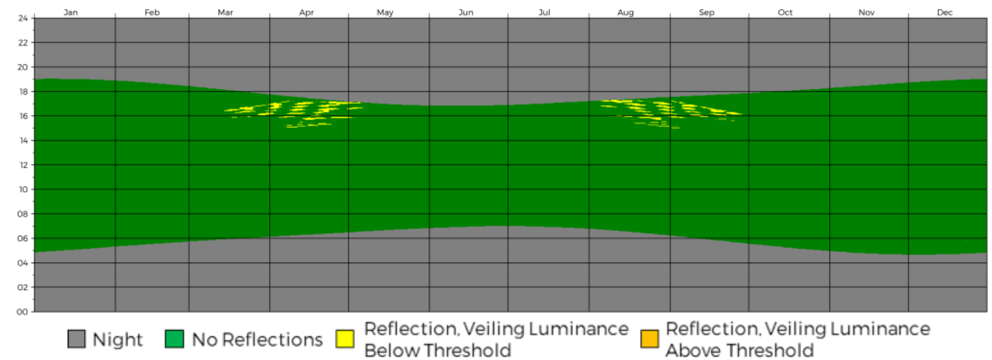

Figure C10: Annual Reflection Impact Diagram for Driver Receptor D10

Driver Receptor D11

Receptor D11 was chosen to assess the visual impact associated with solar reflections affecting eastbound train drivers approaching Newcastle Interchange Station.

The simulations indicated that intermittent reflections may fall on this point during the following periods:

11:15 am to 2:30 pm AEST

- March through April
- Late August through mid-October

2:45 pm to 5:30 pm AEST

- January through April
- Mid-August through November

The maximum veiling luminance predicted was 68 cd/m².

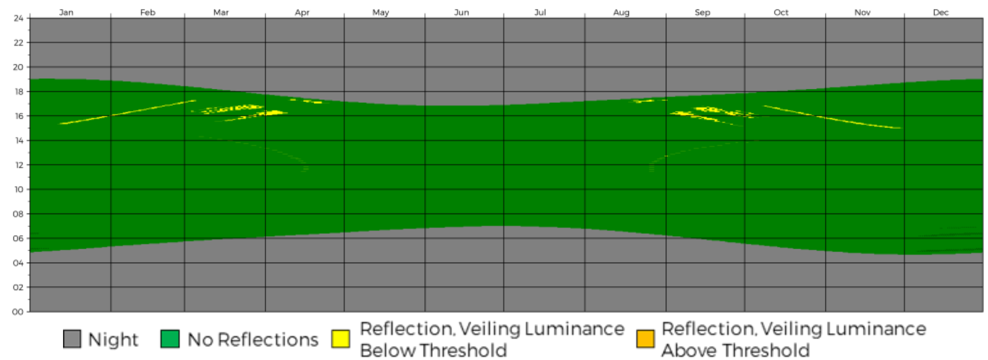

Figure C11: Annual Reflection Impact Diagram for Driver Receptor D11