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Northcote Village
T&P Northcote Development Pty Ltd
Reflected Glare Report

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Executive Summary

Inhabit has been engaged by T&P Northcote Development Pty Ltd to undertake an external reflected glare assessment for the façade of the proposed residential development at Northcote Village. The glare assessment responds to the request by the Department of Transport and Planning (DTP) for a glint / glare and reflectivity assessment for the proposed development.

Reflected glare has been assessed against a veiling luminance performance criterion defined by Hassall (1991) using the Holladay (1927) formula. This assessment considers a reflectivity of 15% (measured normal to surface) for all tower and podium glazing. Other façade elements have been modelled as non-specular based on the proposed matte and other non-reflective finish intents. Sunny clear sky conditions have been assumed and the varying luminous efficacy based on solar elevation (Hassall, 1991) has been used in this analysis. Note this report discusses the building façade only and excludes other elements such as lights and signs from the assessment.

The findings of this study indicate that:

- Reflected glare exceedances occurring from the façade have been observed to some nearby roads and carparks for a low percentage of the year. These exceedances were identified to occur at a glancing angle to the façade, which may be effectively addressed through the implementation of vertical shading fins or similar shading devices. It is considered that all the exceedances identified within this reflected glare assessment occur from a high elevation of the façade such that they can be shaded from drivers manually operating a typical car sun visor.
- Reflected glare is identified to occur to the skylights of Northcote Plaza. However, given that these occur at the same time when the direct glare from the sun would be dominant, these occurrences could be considered acceptable as per the performance criteria used in this report.

Table 1 summarises the results. Inhabit recommend the results of this assessment are reviewed by any relevant transport authorities to ensure any exceedances to the veiling luminance criterion are considered acceptable.

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Table 1: Summary of external reflected glare results

Region	Description	Region Type	Performance Criteria	Annual Frequency Performance Criteria Exceeded
1	Northcote Station (N-bound)	Road (includes tram and train regions)	< 500 Cd/m^2 (Hassall, 1991)	0.0%
2	Northcote Station (S-bound)			0.0%
3	High St (N-bound)			0.0%
4	High St (S-bound)			0.0%
5	Separation St (E-bound)			0.7%
6	Separation St (W-bound)			0.7%
7	Northcote Plaza Road (S-bound)			0.0%
8	Northcote Plaza East Carpark			2.7%
9	Northcote Plaza North Carpark			0.0%
10	Northcote Plaza West Carpark			0.0%
11	8 Breavington Way	Neighbouring building	< 1143 Cd/m^2 (Ho et al., 2011)	0.0%
12	Northcote Plaza (Skylights)			0.0%
13	Santa Maria College			0.0%

The veiling luminance criteria used in this assessment are based on current industry best practice. These limits on reflected glare do not prevent solar reflection from occurring and they do not prevent the possibility that these reflections may still cause annoyance or act as a distraction to motorists. No liability is assumed or implied from this report for any accident where the cause is attributed to annoyance glare or a distraction caused by solar reflections off the building where the façade reflectivity satisfies the nominated limits.

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1.0 Introduction

Inhabit has been engaged by T&P Northcote Development Pty Ltd to assess the façade of the proposed development at Northcote Village, for likelihood of external reflected glare and the potential impact to the surrounding area.



Figure 1: Architectural render of the proposed development (courtesy of Wardle)

1.1 Purpose and Scope

The purpose of this assessment is to determine the frequency that external reflected glare to the surrounding roads and neighbouring buildings exceeds the nominated veiling luminance performance criteria as described in this report.

1.2 Reference Information

This assessment has been based on the following sources of information:

- Architectural drawing set (For DTP Planning Submission), issued by Wardle, dated 5th June 2026.
- 3D model of the proposed building, sent by T&P Northcote Development Pty Ltd on 21st July 2026.

1.3 Reflected Glare

Reflective glazed façades with modern high-performance low-emissivity coatings will always cause a degree of reflected glare impact to the surroundings. Non-matte surfaces including shiny metallic cladding can also result in reflected glare. The solar reflections off a building façade can lead to a number of visual issues.

In addition to causing nuisance to pedestrians or occupants of nearby buildings, visual glare may create a safety hazard to motorists, train drivers and others whose tasks restrict them from simply

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looking away. Glare can also create undesirable patterns of light throughout the urban environment.

To quantify the impact of solar reflections from the development, the following glare factors must be considered:

- Frequency
- Duration
- Intensity
- Receiving location
- Viewing direction

1.4 Limitations

This simulation has been based on the methodology and the assumptions included in this report, using material performance values specific to the project. Where specific material performance values are not available, standard industry values have been used as default.

This report only assesses glare in terms of veiling luminance using the industry standard Hassall Methodology. Due to the subjectivity of visual amenity and comfort, a standard does not exist, and therefore this report does not assess comfort.

Building performance simulations are idealised representations of the actual building that cannot fully represent all of the intricacies of the building once built. As a result, simulation results only represent an interpretation of the building performance. No guarantee or warrantee for the building performance in practice can be based on simulation results alone.

The veiling luminance criteria used in this assessment are based on current industry best practice. These limits on reflected glare do not prevent solar reflection from occurring and they do not prevent the possibility that these reflections may still cause annoyance or act as a distraction to motorists. No liability is assumed or implied from this report for any accident where the cause is attributed to annoyance glare or a distraction caused by solar reflections off the building where the façade reflectivity satisfies the nominated limits.

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2.0 Performance Criteria

2.1 Planning Considerations

The glare assessment responds to the request by the Department of Transport and Planning (DTP) for a glint / glare and reflectivity assessment.

This assessment responds to reflected glare from façade material surfaces.

2.2 Performance Criteria

In line with industry standard for motorists and pedestrians, this assessment adopts a veiling luminance performance criterion of 500 Cd/m² established by Hassall (1991). For neighbouring buildings, a relaxed veiling luminance performance criterion is adopted based on Ho et al. (2011).

In the absence of specific veiling luminance criteria for train and tram operators, the 500 Cd/m² is also applied to the regions where train and trams may operate.

Table 2: Summary of performance criteria adopted

Region Type	Assessment Type	Veiling Luminance Performance Criterion	Reference
Roads	External Reflected Glare	< 500 Cd/m²	Hassall (1991)
Neighbouring buildings		< 1143 Cd/m²	Ho et al., (2011)

2.3 Direct Glare and Reflected Glare

For periods when the unobstructed sun is within the observer's field of view, the veiling luminance caused by the sun (i.e. direct glare) and the reflected sun (i.e. reflected glare) are calculated based on the corresponding angle between the field of view and the glare source.

For instances where the direct glare from the sun is the dominant source of glare when compared to the reflected glare, glare identified as reflected off the façade is considered acceptable, even if the reflected glare exceeds the veiling luminance performance criterion.

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3.0 Site and Context

3.1 Site

The project site is located at 25 Separation Street, Northcote. The proposed development has frontages to Separation St to the south. The proposed development is directly adjacent to Northcote Plaza and is in close proximity to the carparks to the east and north of the development.



Figure 2: Site location and context (Courtesy of Wardle)

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3.2 Critical Observer Locations

Reflected glare from the proposed development for the following nearby regions has been assessed. Figure 3 presents the receiver regions that have been identified for this study through a screening simulation.



Figure 3: Regions identified for detailed study

Table 3 Summary of observer regions

Region	Description	Region Type	Performance Criteria
1	Northcote Station (N-bound)	Road (includes tram and train regions)	< 500 Cd/m^2 (Hassall, 1991)
2	Northcote Station (S-bound)		
3	High St (N-bound)		
4	High St (S-bound)		
5	Separation St (E-bound)		
6	Separation St (W-bound)		
7	Northcote Plaza Road (S-bound)		
8	Northcote Plaza East Carpark		
9	Northcote Plaza North Carpark		
10	Northcote Plaza West Carpark		
11	8 Breavington Way	Neighbouring building	< 1143 Cd/m^2 (Ho et al., 2011)
12	Northcote Plaza (Skylights)		
13	Santa Maria College		

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4.0 Methodology

4.1 Tools and Software

The proposed development and the surrounding buildings have been modelled in 3D modelling software, Rhinoceros 7. An in-house simulation tool developed by Inhabit using Grasshopper was then used to assess the spatial range of glare and quantify the luminance values across the 3D environment. The results are then collated to quantify the annual frequency that the criterion is exceeded. This tool is a 3D implementation of the industry standard Hassall Method, which allows for complex façade and shading geometry to be dynamically assessed.

4.2 Veiling Luminance

For road safety, Hassall (1991) nominates a veiling luminance of 500 candelas per square metre (Cd/m²) as a practical limit for safety. This limit has been derived using the Holladay (1927) formula to determine the risk of glare due to light reflections. A limit of 800 Cd/m² has been adopted for occupants of neighbouring buildings based on Ho et al. (2011), which is factored by an assumed VLT of 70%. Refer to Appendix B for further information.

4.3 Weber-Fechner Law

When considering glare and the relative impact to the sensory system, the relationship between light and perception is logarithmic. This means that for every unit increase in veiling luminance, the increase in perception is only a factor of the change in veiling luminance. This phenomenon can be described by the Weber-Fechner Law of psychophysics and applies to all senses: vision, hearing, taste, touch, and smell.

As this relationship is logarithmic and not linear, the relative impact on the receiver's perception is difficult to quantify and can sometimes be imperceptible to the human eye. As it is not always possible to eliminate reflected glare with glazed facades, understanding this relationship allows for qualitative discussion to contextualise any glare exceedance.

4.4 Spectral and Diffuse Reflection

Reflected glare is defined by the McGraw-Hill Dictionary of Architecture and Construction (2003) as glare resulting from specular reflection of high brightness in polished or glossy surfaces in the field of view. Therefore, when considering the impact of reflected glare, the critical material properties are the combination of reflectivity and specularity together.

Reflectivity in the context of this assessment is a measure of visible light that is reflected from a surface when illuminated by a light source such as the sun.

Specularity can be described as how smooth a surface is on a microscopic level. The higher the surface specularity, the more mirror-like or shiny the surface is. Specular reflection reflects all light which arrives from a given direction at the corresponding opposite angle. Conversely, surfaces with low specularity results in a diffuse reflection caused by light being reflected in a broad range of directions.

It is important to note that a material with high reflectivity and low specularity has less potential to result in reflected glare when compared to a high reflectivity and high specularity. This is due to a lower specular reflection which predominantly drives glare impact. In this assessment, glazed and non-matte metallic façade elements have been defined conservatively as having high specularity.

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5.0 Modelling Inputs

5.1 Annual Sun Path

The assessment has used the sun's position in the sky (azimuth and altitudes) from the following coordinates:

- -37.7695° S, 144.9989° E

5.2 Sky Conditions

Sunny clear sky conditions have been assumed and the varying luminous efficacy based on solar elevation (Hassall, 1991) has been used in this analysis. This represents a conservative scenario for the risk of reflected glare. An overcast or polluted sky will reduce the intensity of solar reflections thereby reducing the risk of glare.

5.3 Time of Analysis

Hourly calculations have been performed for all daylight hours, on the 21st day of each month throughout the year. The 21st day of each month has been selected to account for the summer and winter solstices, covering representative solar positions throughout the year. This time resolution provides an appropriate representation of annual glare impact. Inhabit notes that no daylight savings effects have been taken into account in this assessment.

5.4 Model Geometry

A 3D massing model of the proposed development has been generated based on the architectural drawings. Massing geometry of neighbouring buildings has been included to provide context and accuracy in solar obstructions. Figure 4 below illustrates the 3D model geometry.

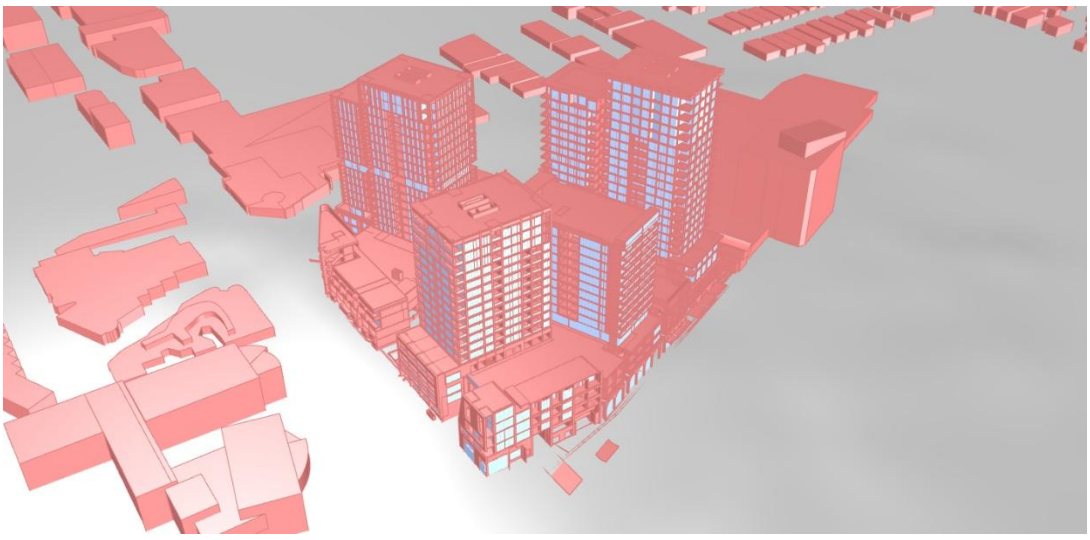


Figure 4: Perspective of model geometry (view from west)

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5.5 Material Properties

Table 4 shows the material properties that have been adopted for this assessment.

Table 4: Material properties assigned

Element	Specular Reflectance	Comment
Typical façade glazing (tower and podium levels)	15%	Nominal external reflectivity limit
Opaque elements (i.e., clad spandrels, concrete, brick, and metal finishes)	-	Assumed to be a non-specular material
Metal rail balustrades	-	Assumed to be a non-specular material. Shading effects of the metal rails are conservatively excluded from the model.

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6.0 Results

6.1 Reflected Glare

Table 5 summarises the annual frequency that the performance criterion is exceeded within each study region. It is recommended that these results are interpreted in conjunction with the discussion in subsequent sections to understand the likely impact to traffic.

Table 5: Summary of reflectivity results

Region	Description	Region Type	Performance Criteria	Annual Frequency Performance Criteria Exceeded
1	Northcote Station (N-bound)	Road (includes tram and train regions)	< 500 Cd/m^2 (Hassall, 1991)	0.0%
2	Northcote Station (S-bound)			0.0%
3	High St (N-bound)			0.0%
4	High St (S-bound)			0.0%
5	Separation St (E-bound)			0.7%
6	Separation St (W-bound)			0.7%
7	Northcote Plaza Road (S-bound)			0.0%
8	Northcote Plaza East Carpark			2.7%
9	Northcote Plaza North Carpark			0.0%
10	Northcote Plaza West Carpark			0.0%
11	8 Breavington Way	Neighbouring building	< 1143 Cd/m^2 (Ho et al., 2011)	0.0%
12	Northcote Plaza (Skylights)			0.0%
13	Santa Maria College			0.0%

Charts in the following section (Section 6.1.1) indicate the times of year when potential reflected glare exceeds the performance criteria in each region.

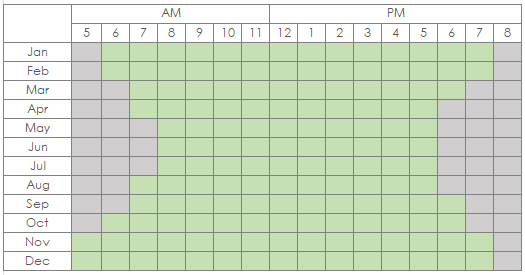
The charts display results which are coloured according to the below:

- Grey highlights indicate when the solar elevation is calculated to be below the horizon and therefore reflections from the façade are not possible.
- Green highlights indicate when there is either no reflected glare, or when the reflected glare does not exceed the performance criteria.
- Orange highlights indicate when the performance criteria have been exceeded.
- Purple highlights indicate when the performance criteria are exceeded but the sun is the dominant source of glare. In these instances, the reflected glare from the building façade is considered acceptable because direct glare from the sun will be dominant.

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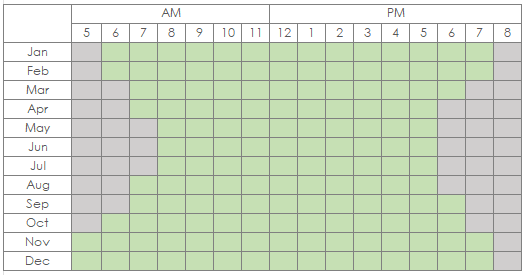
6.1.1 Regions

Northcote Station (N-bound)



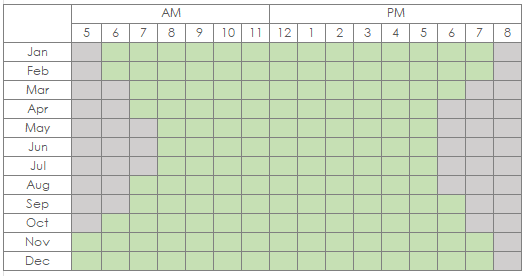
500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

Northcote Station (S-bound)



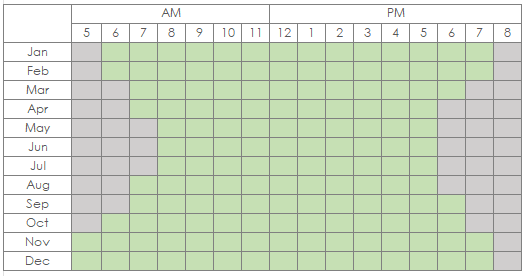
500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

High St (N-bound)



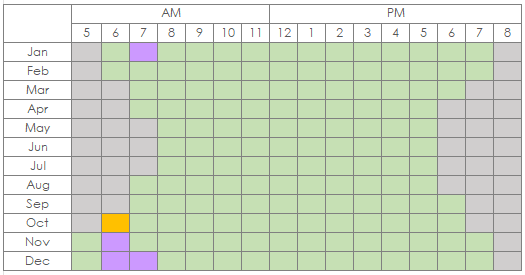
500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

High St (S-bound)



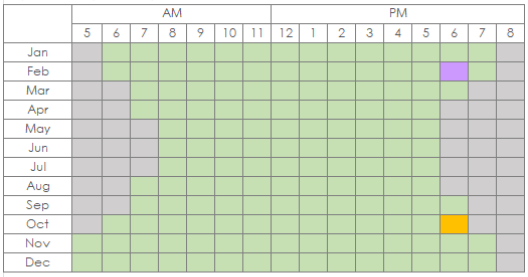
500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

Separation St (E-bound)



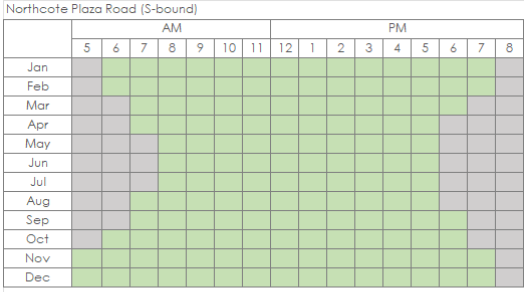
500	Veiling Luminance Criterion (Cd/m²)
96.6%	Acceptable - Within performance criteria
2.7%	Acceptable - Exposure to direct and reflected glare
0.7%	Criteria exceeded - Exposure to reflected glare only

Separation St (W-bound)



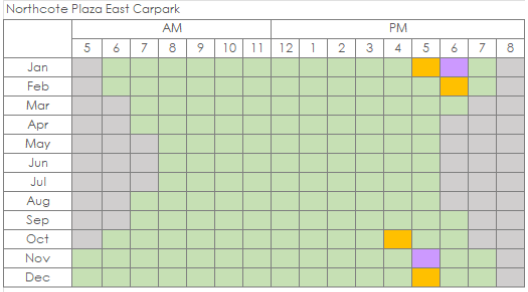
500	Veiling Luminance Criterion (Cd/m²)
98.6%	Acceptable - Within performance criteria
0.7%	Acceptable - Exposure to direct and reflected glare
0.7%	Criteria exceeded - Exposure to reflected glare only

Northcote Plaza Road (S-bound)



500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

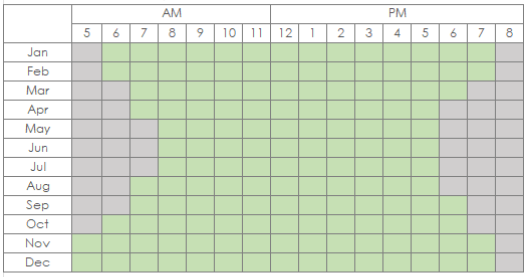
Northcote Plaza East Carpark



500	Veiling Luminance Criterion (Cd/m²)
95.9%	Acceptable - Within performance criteria
1.4%	Acceptable - Exposure to direct and reflected glare
2.7%	Criteria exceeded - Exposure to reflected glare only

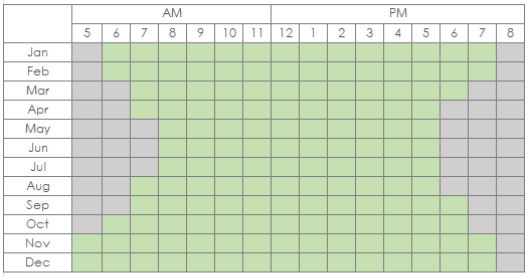
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Northcote Plaza North Carpark



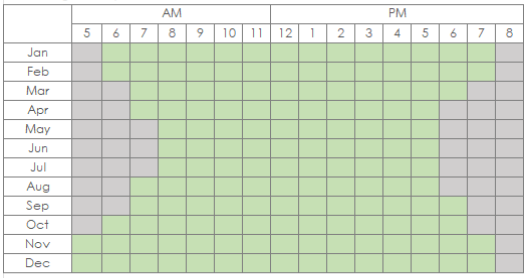
500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

Northcote Plaza West Carpark



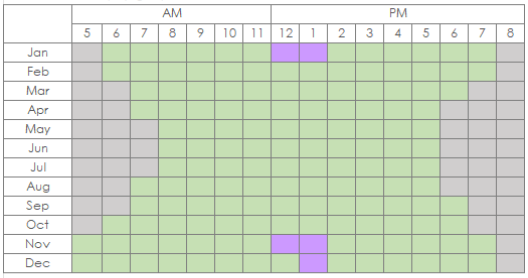
500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

8 Breavington Way



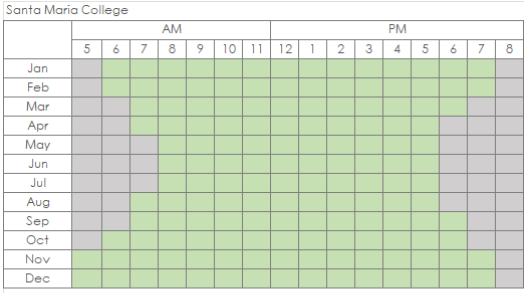
1143	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

Northcote Plaza (Skylights)



1143	Veiling Luminance Criterion (Cd/m²)
96.6%	Acceptable - Within performance criteria
3.4%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

Santa Maria College



1143	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

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7.0 Discussion

Table 6 summarises the key findings from the assessment. Refer to Appendix A for detailed modelling images.

Table 6: Discussion of reflectivity results

Region	Description	Annual Frequency Performance Criteria Exceeded	Comments
1	Northcote Station (N-bound)	0.0%	No exceedances identified
2	Northcote Station (S-bound)	0.0%	
3	High St (N-bound)	0.0%	
4	High St (S-bound)	0.0%	
5	Separation St (E-bound)	0.7%	Glare exceedances caused by glancing reflections from the south elevation of Building 2 were identified to occur during mornings in shoulder months (approximately 6AM in October). The mitigation strategy for these glare exceedances could include adding vertical shading fins to the south façade elevation to shade the reflections. Additional glare occurrences which exceed the performance criterion were also identified, however as the sun is the dominant source of glare in the driver's field of the view at the same time, this is considered acceptable as per the performance criterion. It is noted that all exceedances occur from a source above 5° from the driver's viewing direction. Therefore, these exceedances may be able to be shaded by a typical car sun visor.
6	Separation St (W-bound)	0.7%	Glare exceedances caused by glancing reflections from the south elevation of Building 2 & 5 were identified to occur during early evenings in shoulder months (approximately 6PM in October). The mitigation strategy for these glare exceedances could include adding vertical shading fins to the south façade elevation to shade the reflections. Additional glare occurrences which exceed the performance criterion are also identified, however as the sun is the dominant source of glare in the driver's field of the view at the same time, this is considered acceptable as per the performance criterion.

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			It is noted that all exceedances occur from a source above 5° from the driver's viewing direction. Therefore, these exceedances may be able to be shaded by a typical car sun visor.
7	Northcote Plaza Road (S-bound)	0.0%	No exceedances identified
8	Northcote Plaza East Carpark	2.7%	Glare exceedances caused by glancing reflections from the north elevation of Building 1,2 & 3 were identified to occur during early evenings in shoulder months and summer months (from October to February). The mitigation strategy for these glare exceedances could include adding vertical shading fins to the north façade elevation to shade the reflections. It is noted that all exceedances occur from a source above 5° from the driver's viewing direction. Therefore, these exceedances may be able to be shaded by a typical car sun visor.
9	Northcote Plaza North Carpark	0.0%	No exceedances identified
10	Northcote Plaza West Carpark	0.0%	No exceedances identified
11	8 Breavington Way	0.0%	No exceedances identified
12	Northcote Plaza (Skylights)	0.0%	Glare occurrences to the Northcote Plaza skylights which exceed the performance criterion were identified. However, the sun is the dominant source of glare at the same time, and this can therefore be considered acceptable as per the performance criterion.
13	Santa Maria College	0.0%	No exceedances identified

7.1 Mitigation Strategies

Reflected glare exceedances have been identified to occur to nearby roads and carparks, particularly resulting from glancing reflections (i.e., reflections are close to parallel with the façade line). Due to the angular-dependent reflectivity properties of glass, which is more reflective when observing a glancing reflection, reducing the glazing reflectivity limit is not an effective mitigation strategy. Glancing reflections are most effectively mitigated by using vertical shading fins or other shading devices which can shade the sun from oncoming drivers. Additional studies to develop the shading strategy further can be reviewed with the design team to determine whether this can be implemented while achieving the desired design intent.

However, it is noted that the exceedances identified to roads and carparks occur from a high elevation on the façade above 5° from the driver's viewing direction. Drivers could operate a typical car sun visor to manually shade the reflected glare observed from the facade.

Data sensitivity - Internal

8.0 Conclusion

Inhabit has been engaged by T&P Northcote Development Pty Ltd to undertake an external reflected glare assessment for the façade of the proposed development at Northcote Village. The glare assessment responds to the request by the Department of Transport and Planning (DTP) for a glint / glare and reflectivity assessment for the proposed development.

Reflected glare has been assessed against a veiling luminance performance criterion defined by Hassall (1991) using the Holladay (1927) formula. This assessment considers a reflectivity of 15% (measured normal to surface) for all tower and podium glazing. Other façade elements have been modelled as non-specular based on the proposed matte and other non-reflective finish intents. Sunny clear sky conditions have been assumed and the varying luminous efficacy based on solar elevation (Hassall, 1991) has been used in this analysis. Note this report discusses the building façade only and excludes other elements such as lights and signs from the assessment.

The findings of this study indicate that reflected glare exceedances occurring from the façade have been observed to some nearby roads and carparks. These exceedances were identified to occur at a glancing angle to the façade, which is most effectively addressed through the implementation of vertical shading fins or similar shading devices. It is considered that all the exceedances identified within this reflected glare assessment occur from a high elevation of the façade such that they can be shaded from drivers manually operating a typical car sun visor.

9.0 References

- Hassall, David N. H. 1991, Reflectivity: dealing with rogue solar reflections / written and illustrated by David N.H. Hassall D.N.H. Hassall] [Newport, N.S.W].
- Holladay, L. L. 1927, Action of a Light-Source in the Field of View in Lowering Visibility, J. Opt. Soc. Am. 14, 1-15.
- Ho, C.K., Ghanbari, C.M. and Diver, R.B., 2011. Methodology to assess potential glint and glare hazards from concentrating solar power plants: Analytical models and experimental validation, Journal of Solar Energy Engineering

Data sensitivity - Internal

A Appendix A – Detailed Results

The following charts present the maximum veiling luminance in each region throughout the year.

A.1 Region 1

Northcote Station (N-bound)

	AM							PM								
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0
Feb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
May	0	0	0	35	0	0	0	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

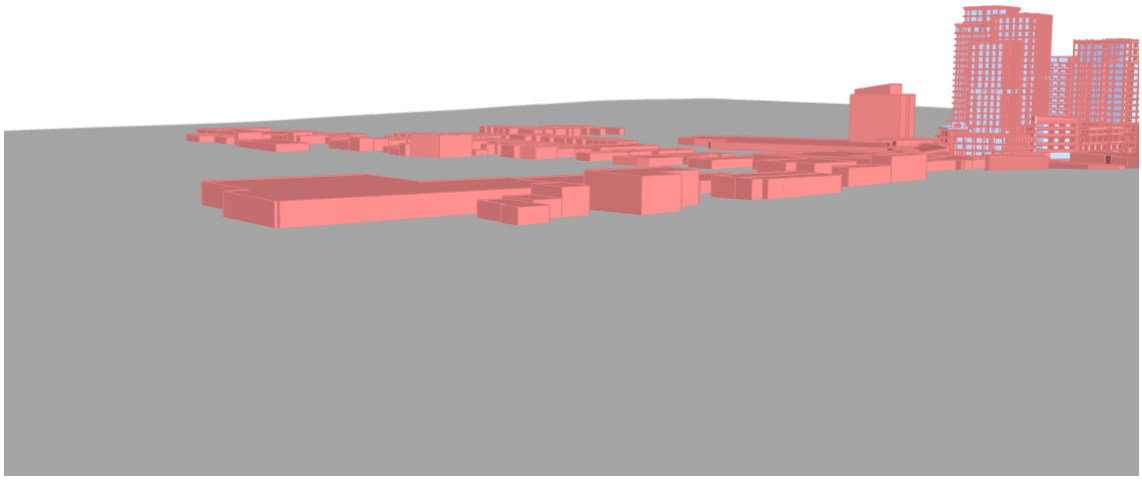


Figure 5: Representative perspective along railway line to Northcote Station (N-bound). No exceedances identified.

Data sensitivity - Internal

A.2 Region 2

Northcote Station (S-bound)

	AM							PM								
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

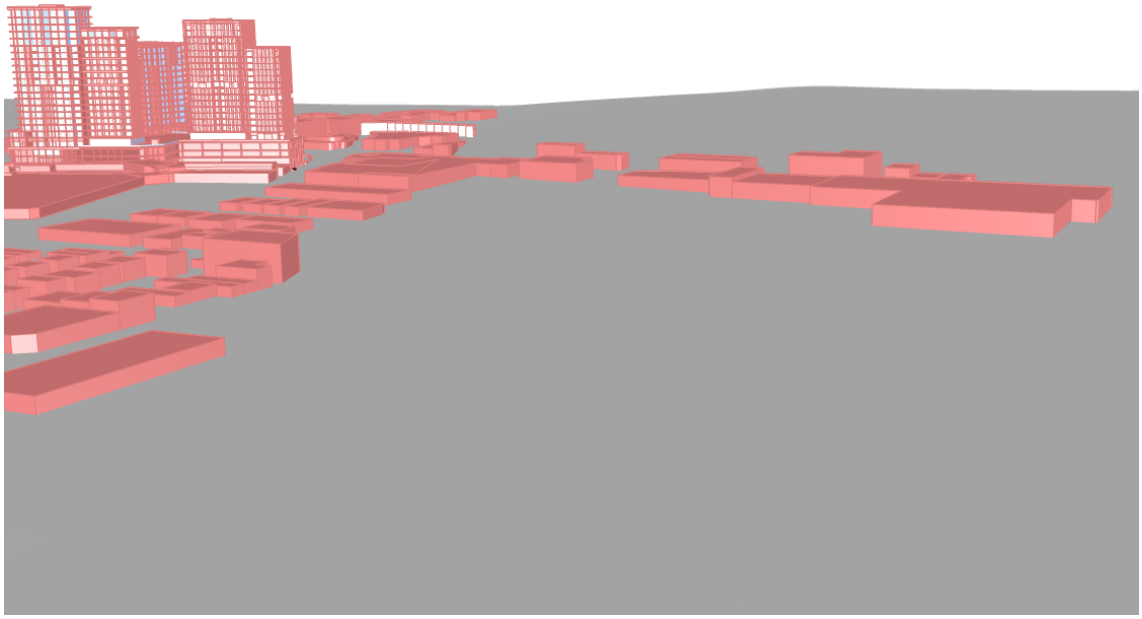


Figure 6: Representative perspective along railway line to Northcote Station (S-bound). No exceedances identified.

Data sensitivity - Internal

A.3 Region 3

High St (N-bound)

	AM							PM								
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Jan	0	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	52	0	0	0	0	0	0	0	0	0	0	14	0	0
Mar	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0
Apr	0	0	0	0	0	0	0	0	0	0	0	0	51	0	0	0
May	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0	0	0	0	60	0	0	0
Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

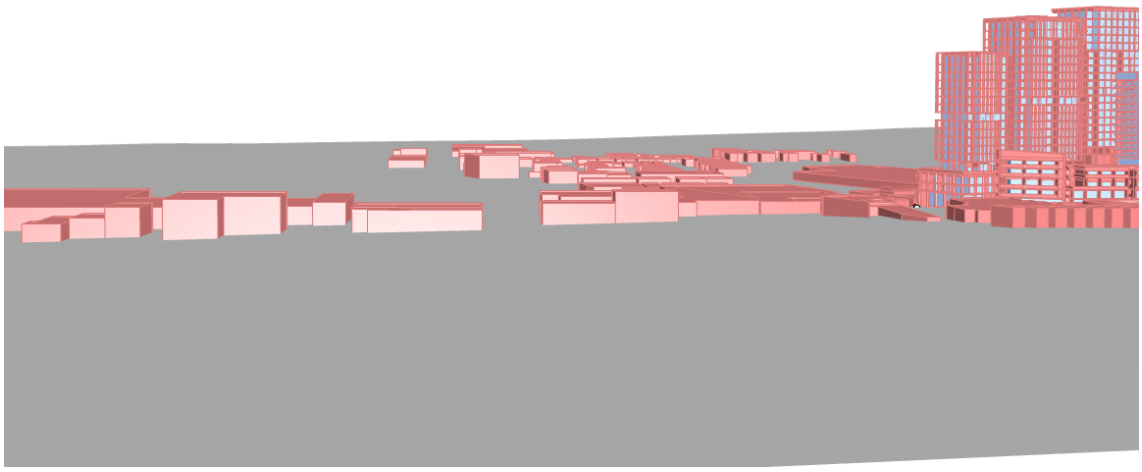


Figure 7: Representative perspective along High St (N-bound). No exceedances identified.

Data sensitivity - Internal

A.4 Region 4

High St (S-bound)

	AM							PM								
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
Aug	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0
Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0

500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

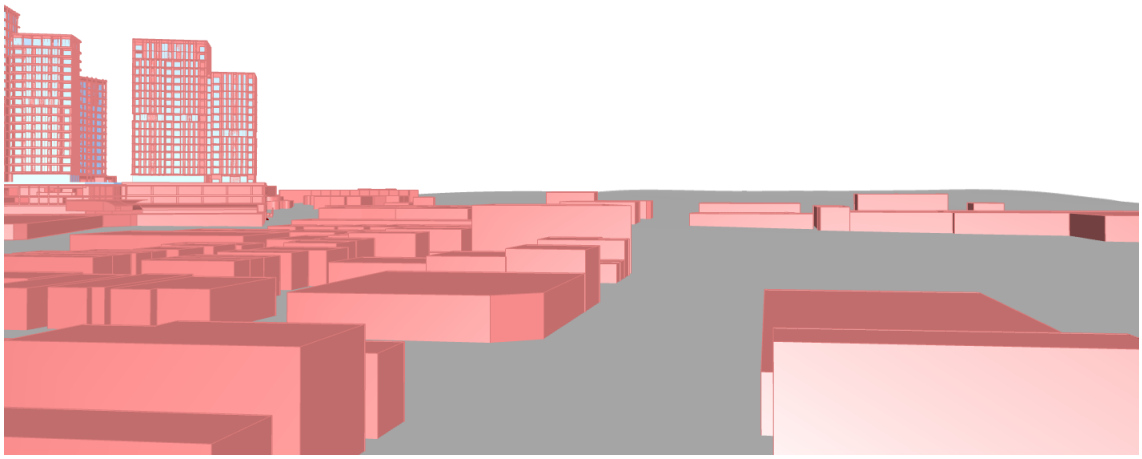


Figure 8: Representative perspective along High St (S-bound). No exceedances identified.

Data sensitivity - Internal

A.5 Region 5

Separation St (E-bound)

	AM							PM								
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Jan	0	428	1214^	117	221	0	0	0	0	0	0	40	64	83	104	0
Feb	0	271	0	0	0	0	0	0	0	0	70	0	44	47	0	0
Mar	0	0	0	0	0	0	0	0	0	0	69	132	245	13	0	0
Apr	0	0	0	0	0	0	0	0	0	0	62	0	144	0	0	0
May	0	0	0	0	0	0	0	0	0	0	0	56	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0	0	0	44	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0	0	35	52	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0	0	60	0	146	0	0	0
Sep	0	0	0	0	0	0	0	0	0	0	79	159	330	7	0	0
Oct	0	4052'	0	0	0	0	0	0	0	55	89	34	39	42	0	0
Nov	13	989^	0	161	279	0	0	0	0	0	0	48	61	96	0	0
Dec	0	515^	885^	103	181	0	0	0	0	0	0	49	80	104	160	0

500	Veiling Luminance Criterion (Cd/m²)
96.6%	Acceptable - Within performance criteria
2.7%	Acceptable - Exposure to direct and reflected glare
0.7%	Criteria exceeded - Exposure to reflected glare only

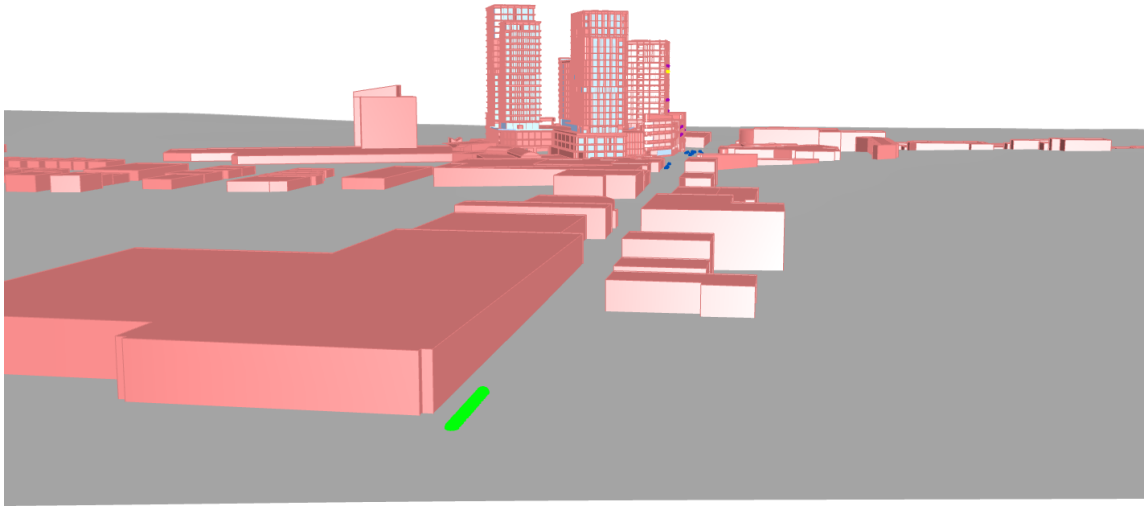


Figure 9: Representative perspective along Separation St (S-bound). Glare exceedances were identified. Where the performance criterion is exceeded, the reflector points are in yellow, and receiver points are in green.

As discussed in Section 7.0, it is noted that all exceedances occur from a source above 5° from the driver's viewing direction. Therefore, these exceedances may be able to be shaded by a typical car sun visor.

Data sensitivity - Internal

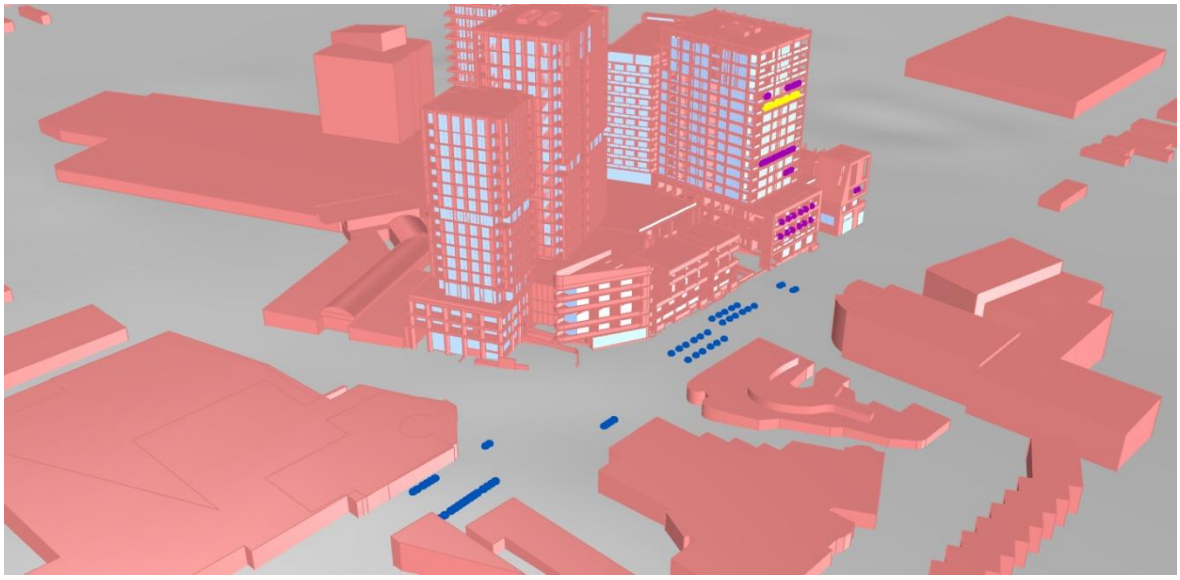


Figure 10: South elevation of the building, showing relevant glazing panels causing reflected glare exceedances along Separation St (E-bound).

The results from this image are as follows:

- Where the performance criterion is exceeded, the reflector points are in yellow, and receiver points are in green. These exceedances occur from a source above 5° from the driver's viewing direction and may be able to be shaded by a typical car sun visor.
- This location also includes times when the reflected glare exceedance is dominated by direct glare from the sun. In these cases, the reflector points are in purple, and receiver points are in blue. While these reflections exceed the performance criterion, as the sun is the dominant source of glare in the driver's field of the view at the same time, this is considered acceptable as per the performance criterion.

Data sensitivity - Internal

A.6 Region 6

Separation St (W-bound)

	AM							PM								
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	357	100	0
Feb	0	0	0	176	108	65	0	0	0	0	0	0	0	1012^	0	0
Mar	0	0	278	129	88	54	0	0	0	0	0	0	0	0	0	0
Apr	0	0	0	66	48	43	0	96	0	0	0	0	0	0	0	0
May	0	0	0	28	31	0	0	98	0	0	0	0	0	0	0	0
Jun	0	0	0	0	27	0	0	98	0	0	0	0	0	0	0	0
Jul	0	0	0	22	32	0	0	100	0	0	0	0	0	0	0	0
Aug	0	0	0	67	47	44	0	96	0	0	0	0	0	0	0	0
Sep	0	0	243	108	77	0	0	0	0	0	0	0	0	0	0	0
Oct	0	0	0	153	82	0	0	0	0	0	0	0	0	601'	0	0
Nov	0	0	0	0	0	0	0	0	0	0	0	0	471	263	0	0
Dec	0	0	0	0	0	0	0	0	0	0	0	0	449	229	0	0

500	Veiling Luminance Criterion (Cd/m²)
98.6%	Acceptable - Within performance criteria
0.7%	Acceptable - Exposure to direct and reflected glare
0.7%	Criteria exceeded - Exposure to reflected glare only

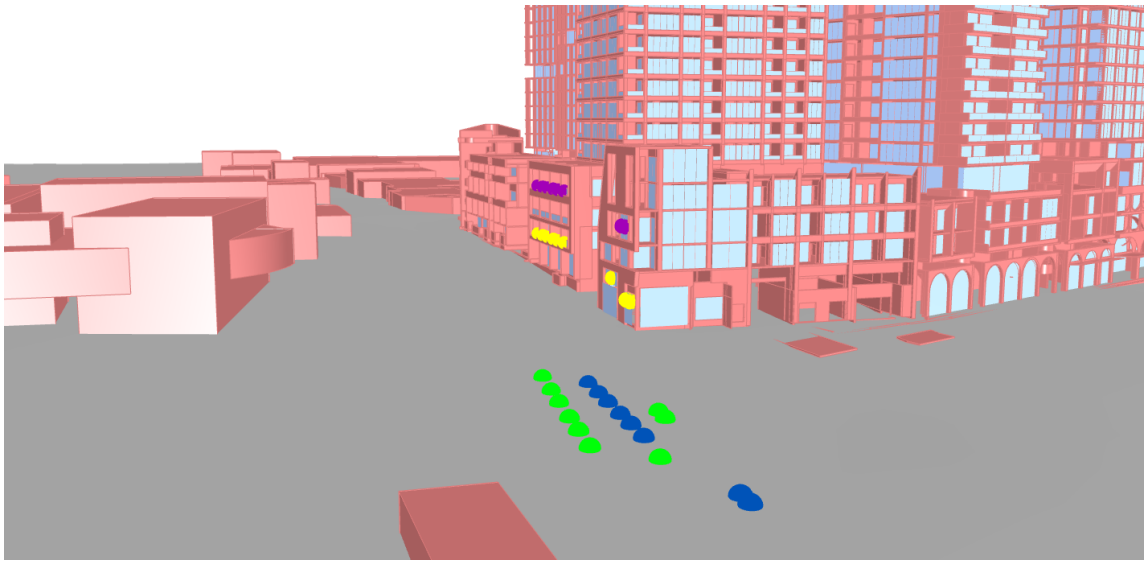


Figure 11: Representative perspective along Separation St (N-bound).

The results from this image are as follows:

- Where the performance criterion is exceeded, the reflector points are in yellow, and receiver points are in green. These exceedances occur from a source above 5° from the driver's viewing direction and may be able to be shaded by a typical car sun visor.
- This location also includes times when the reflected glare exceedance is dominated by direct glare from the sun. In these cases, the reflector points are in purple, and receiver points are in blue. While these reflections exceed the performance criterion, as the sun is the dominant source of glare in the driver's field of the view at the same time, this is considered acceptable as per the performance criterion.

Data sensitivity - Internal

A.7 Region 7

Northcote Plaza Road (S-bound)

	AM							PM								
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0	49	0	0	0	0	0	0	0	0
May	0	0	0	0	48	61	0	56	107	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	68	55	108	85	119	0	0	0	0	0
Jul	0	0	0	0	0	55	0	51	97	0	0	0	0	0	0	0
Aug	0	0	0	0	152	0	0	47	0	0	0	0	0	0	0	0
Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

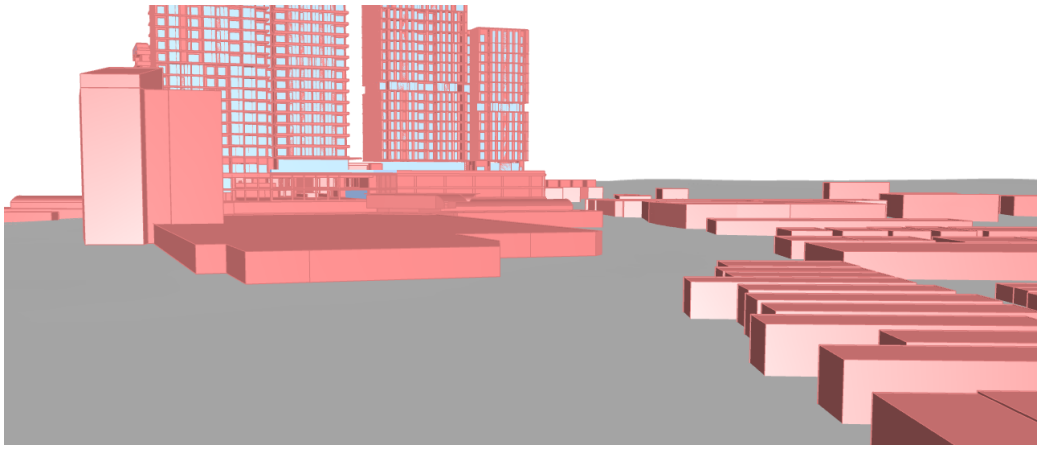


Figure 12: Representative perspective along Northcote Plaza Road (S-bound). No glare exceedances were identified.

Data sensitivity - Internal

A.8 Region 8

Northcote Plaza East Carpark

	AM							PM								
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Jan	0	27	171	126	102	75	0	0	0	0	0	193	526'	1481^	0	0
Feb	0	0	119	158	139	87	0	0	0	0	202	467	306	804'	0	0
Mar	0	0	245	297	178	92	57	0	0	0	201	0	110	0	0	0
Apr	0	0	0	362	126	83	50	0	0	0	0	0	0	0	0	0
May	0	0	0	164	95	55	44	0	0	0	0	0	0	0	0	0
Jun	0	0	0	83	86	51	44	0	0	0	0	0	0	0	0	0
Jul	0	0	0	156	105	59	47	0	0	0	0	0	0	0	0	0
Aug	0	0	0	408	133	86	51	0	0	0	0	0	0	0	0	0
Sep	0	0	381	252	150	81	0	0	0	0	251	0	0	0	0	0
Oct	0	51	160	181	112	72	0	0	0	129	305	677'	385	0	0	0
Nov	0	314	124	121	91	66	0	0	0	0	327	281	673^	0	0	0
Dec	0	481	158	107	88	67	0	0	0	0	117	277	779'	0	0	0

500	Veiling Luminance Criterion (Cd/m²)
95.9%	Acceptable - Within performance criteria
1.4%	Acceptable - Exposure to direct and reflected glare
2.7%	Criteria exceeded - Exposure to reflected glare only

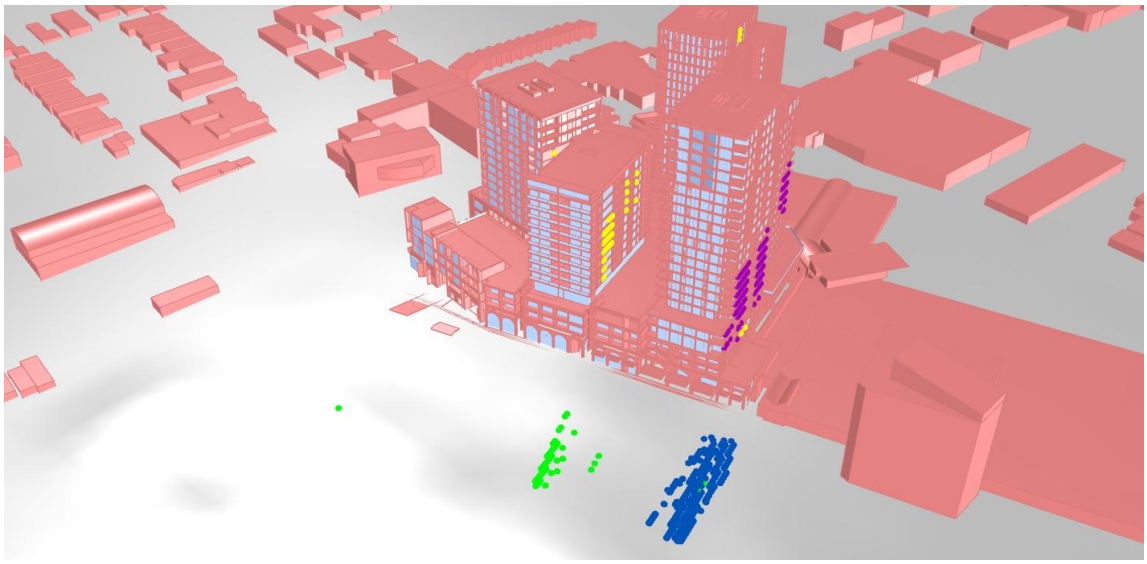


Figure 13: North-east perspective of the building, showing relevant glazing panels causing reflected glare exceedances to the Northcote Plaza East Carpark.

The results from this image are as follows:

- Where the performance criterion is exceeded, the reflector points are in yellow, and receiver points are in green. These exceedances occur from a source above 5° from the driver's viewing direction and may be able to be shaded by a typical car sun visor.
- This location also includes times when the reflected glare exceedance is dominated by direct glare from the sun. In these cases, the reflector points are in purple, and receiver points are in blue. While these reflections exceed the performance criterion, as the sun is the dominant source of glare in the driver's field of the view at the same time, this is considered acceptable as per the performance criterion.

Data sensitivity - Internal

A.9 Region 9

Northcote Plaza North Carpark

	AM							PM								
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0	0	0	0	0	277	0	0	0	0
May	0	0	0	0	0	0	0	0	0	0	162	279	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0	0	294	390	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0	0	140	300	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0	0	0	256	0	0	0	0
Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0	0	0	0	217	0	0	0
Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

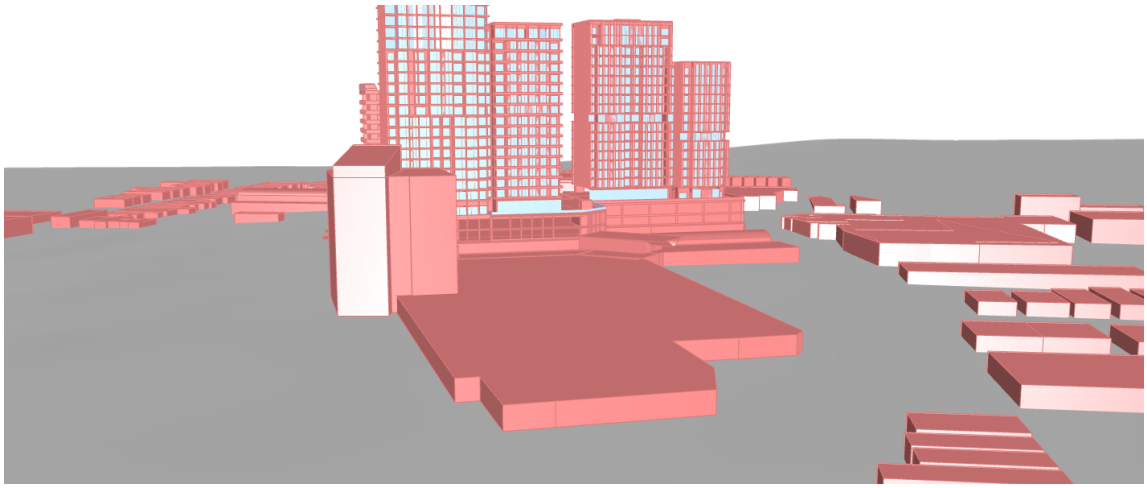


Figure 14: Representative perspective for Northcote Plaza North Carpark. No glare exceedances were identified.

Data sensitivity - Internal

A.10 Region 10

Northcote Plaza West Carpark

	AM							PM								
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	62	0	0	57	0	0	58	0	0	0	0	0
Apr	0	0	0	0	88	61	49	79	114	136	119	31	0	0	0	0
May	0	0	0	0	0	25	57	99	160	206	128	0	0	0	0	0
Jun	0	0	0	0	0	23	57	103	176	192	155	0	0	0	0	0
Jul	0	0	0	0	0	0	52	91	150	204	139	18	0	0	0	0
Aug	0	0	0	0	85	60	47	76	112	135	121	31	0	0	0	0
Sep	0	0	0	0	0	0	0	0	81	0	68	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

500	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

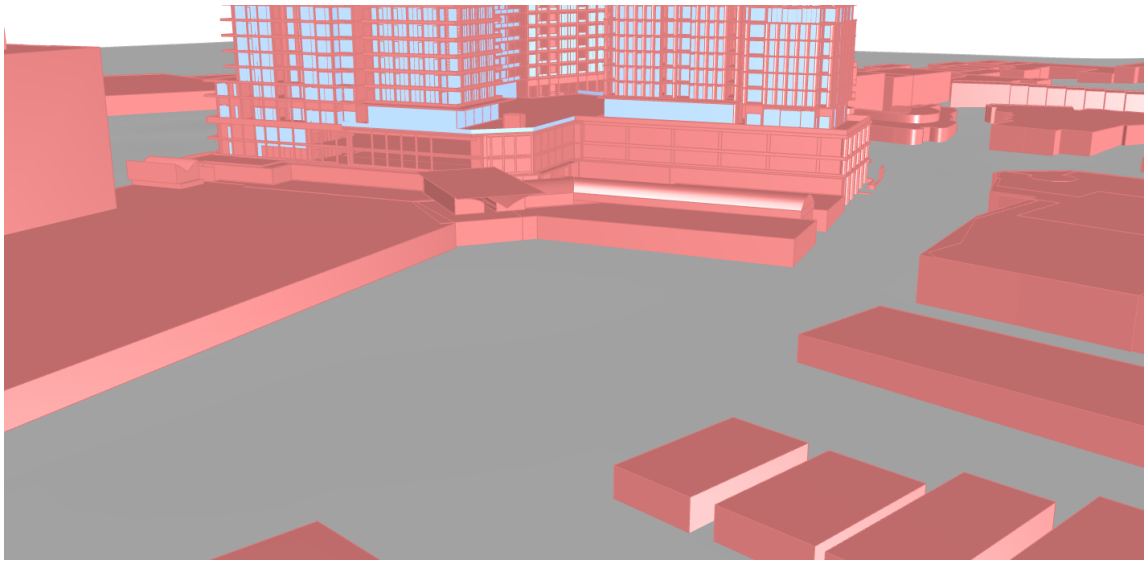


Figure 15: Representative perspective for Northcote Plaza West Carpark. No glare exceedances were identified.

Data sensitivity - Internal

A.11 Region 11

8 Breavington Way

	AM							PM								
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0	0	79	76	0	0	0	0
Mar	0	0	0	0	0	0	0	75	79	76	115	41	0	0	0	0
Apr	0	0	0	0	0	0	0	98	119	114	84	35	13	0	0	0
May	0	0	0	0	0	0	0	0	174	168	83	39	5	0	0	0
Jun	0	0	0	0	0	0	0	29	0	158	97	44	3	0	0	0
Jul	0	0	0	0	0	0	0	31	0	174	92	45	9	0	0	0
Aug	0	0	0	0	0	0	0	101	118	116	86	37	15	0	0	0
Sep	0	0	0	0	0	0	0	69	80	74	56	37	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0	76	81	0	0	0	0	0
Nov	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1143	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only



Figure 16: Representative perspective for 8 Breavington Way. No glare exceedances were identified.

Data sensitivity - Internal

A.12 Region 12

Northcote Plaza (Skylights)

	AM							PM								
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Jan	0	0	0	0	0	0	0	2487^	2111^	882	366	79	0	0	0	0
Feb	0	0	0	0	0	0	533	706	631	359	175	86	0	0	0	0
Mar	0	0	0	0	0	121	162	190	169	114	62	0	0	0	0	0
Apr	0	0	0	0	0	43	58	66	74	41	0	0	0	0	0	0
May	0	0	0	0	0	0	0	54	36	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	57	38	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	56	65	77	45	0	0	0	0	0	0
Sep	0	0	0	0	91	127	167	186	155	99	52	0	0	0	0	0
Oct	0	0	0	0	0	409	575	652	461	239	117	0	0	0	0	0
Nov	0	0	0	0	0	0	0	2512^	1462^	587	259	52	0	0	0	0
Dec	0	0	0	0	0	0	0	0	2968^	1019	0	77	0	0	0	0

1143	Veiling Luminance Criterion (Cd/m²)
96.6%	Acceptable - Within performance criteria
3.4%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only

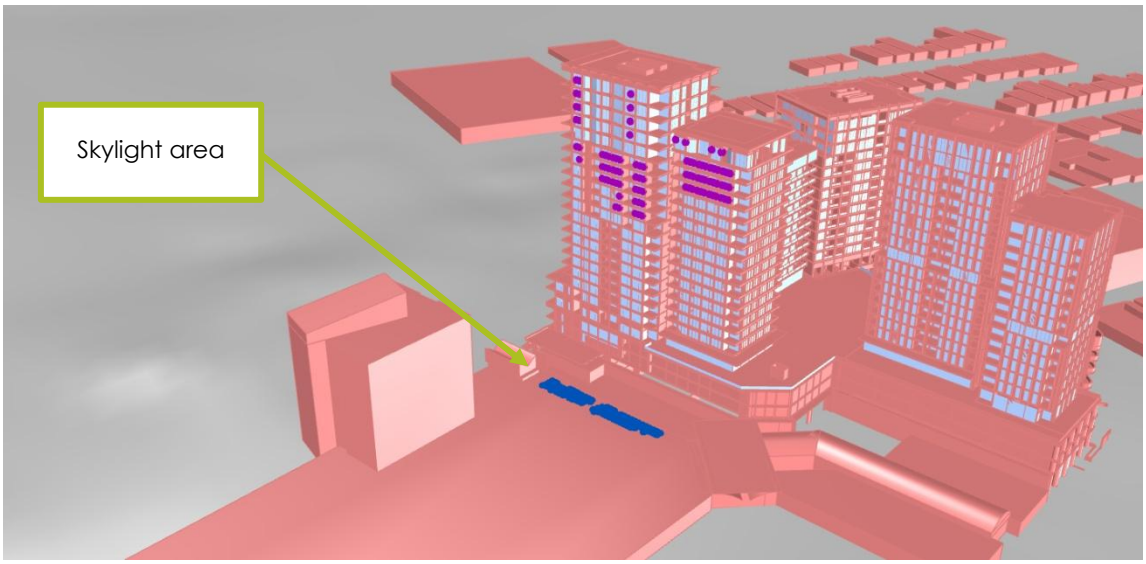


Figure 17: Representative perspective for Northcote Plaza Skylights. Reflected glare exceedances are dominated by direct glare from the sun. In these cases, the reflector points are in purple, and receiver points are in blue.

As discussed in Section 7.0, glare occurrences to the Northcote Plaza skylights which exceed the performance criterion were identified. However, the sun is the dominant source of glare at the same time, and this can therefore be considered acceptable as per the performance criterion.

Data sensitivity - Internal

A.13 Region 13

Santa Maria College

	AM							PM								
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Jan	0	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0	0	222	0	319	0	0	0	0	0
May	0	0	0	0	0	0	0	0	304	633	0	261	0	0	0	0
Jun	0	0	0	0	0	0	0	0	386	0	0	382	0	0	0	0
Jul	0	0	0	0	0	0	0	0	366	0	0	304	0	0	0	0
Aug	0	0	0	0	0	0	0	0	241	0	325	0	0	0	0	0
Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1143	Veiling Luminance Criterion (Cd/m²)
100.0%	Acceptable - Within performance criteria
0.0%	Acceptable - Exposure to direct and reflected glare
0.0%	Criteria exceeded - Exposure to reflected glare only



Figure 18: Representative perspective for Santa Maria College. No glare exceedances were identified.

Data sensitivity - Internal

B Appendix B – Calculation of Veiling Luminance

This glare assessment has been calculated using the Holladay formula that determines a veiling luminance of 500 Cd/m² is a practical limit to the amount of reflected solar glare to which a driver should be exposed. While this criterion is an appropriate limit for vehicle drivers for safety, the limit for pedestrians is higher given the nature of their activity.

The Holladay formula below calculates the equivalent veiling luminance or glare. It assesses the acceptability of solar reflections that fall within a driver's field of vision:

$$L_v\left(\frac{Cd}{m^2}\right) = \frac{10 \cdot EG}{\theta^2} \qquad \textbf{Equation 1}$$

- Lv is the equivalent veiling luminance or glare
- θ is the angle between the centre of the glare source and the line of sight. It is valid from 1.5° to 60°.
- EG is the illumination on the observer's eye produced by the glare source in the plane perpendicular to the line of sight in lux. It is calculated using the following formula.

$$\mathrm{EG} = \mathrm{E.R.}\cos\theta \qquad \textbf{Equation 2}$$

- E is the solar illumination (lux) on the surface, calculated as a product of solar power (W/m²) and luminous efficacy (lumens/W). Solar power is calculated as a function of the altitude (ALT) of the sun and is as per the following formula.

$$\text{Solar Power } (\mathrm{W/m^2}) = \mathrm{ALT} * 50 \ (\text{For ALT} \leq 10°)$$

$$\text{Solar Power } (\mathrm{W/m^2}) = 500 + (\mathrm{ALT} - 10) * 15 \ (\text{For ALT} > 10°) \qquad \textbf{Equation 3}$$

- Luminous efficacy has been used based on sun altitudes as per the Hassall method.
- R is the angular dependent reflectance of the surface.

The issue of solar glare and its effect on human vision is very complex and one for which science has not so far provided a definitive answer. One of the main problems is the great variation in individual human response to a given amount of glare. One person's slight inconvenience is another's blinding light.

The equivalent veiling luminance method models the sun path in relation to the proposed building development. Reflection conditions are modelled for all daylight hours throughout the year. This method is more accurate as it depends on the power of the solar radiation (W/m²) for various altitudes, luminance efficacy (lumens/watt), sun position (azimuth and altitude) for various times of the day, observer's viewing direction (bearing), aspect of reflecting surface, reflectivity and specularity of surface.

This assessment assumes specular reflective façade surfaces, where the reflected ray angle is equal to the incident solar ray angle. It assumes that the equivalent veiling luminance is only calculated for periods of the day when the sun's azimuth is no greater than 90° of the various aspects of the proposed development.

Data sensitivity - Internal