SOLAR LIGHT REFLECTIVITY ANALYSIS

311 HUME HWY, LIVERPOOL

WC178-02F02(REV1)- SR REPORT

9 JULY 2015

Prepared for:

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DOCUMENT CONTROL

Date	Revision History	Non-Issued Revision	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
06/07/2015	Update of previous report (Windtech Reference WC178-01F02(rev0)), Tower height increased to 33 Levels.	-	0	MC	TR	TH
09/07/2015	Referenced ADG	-	1	MC	TR	TH

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EXECUTIVE SUMMARY

This report presents the results of a detailed study for the effect of potential solar glare from the proposed development located at the 311 Hume Highway Liverpool. The analysis has been undertaken based on the architectural drawings prepared by the project architect Design Workshop Australia, received June 2015. This study aims to identify any possible adverse reflected solar glare conditions affecting motorists and pedestrians within the local surrounding area, and to occupants of neighbouring buildings. If necessary, recommendations will be made to mitigate any potentially adverse effects.

This Study assesses compliance with the controls for solar glare from State Environmental Planning Policy No. 65 (SEPP65, Part 04 (Designing the Building) for Amenity), which contains the Apartment Design Guide (ADG). This study also assesses compliance with the planning control requirements of the Liverpool Development Control Plan 2008, which are essentially similar to the controls for solar glare from SEPP65

A site survey has been undertaken to obtain photographs of the critical sightlines of drivers on the surrounding streets. These photographs are calibrated and are able to be overlaid with a glare meter, which allows us to determine the extent, if any, of potential solar glare reflections from the subject development.

The results of the study indicate that, to avoid any adverse glare to drivers and pedestrians on the surrounding streets, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, it is recommended that;

- All glazing used on the western façade of the Tower from Level 3 through to Level 23 should have a maximum normal specular reflectance of visible light of 11%.
- The glazing used for the balustrades and glazed façade which is not shielded by louvres from Ground Level through to Level 23 on the eastern façade of the Tower should have a maximum normal specular reflectance of visible light of 11%.
- All glazing used on the northern façade of Commercial A and Unit 07 from Level 2 through to Level 23 should have a maximum normal specular reflectance of visible light of 11%.
- The glazing used on all levels of the western façade of Buildings A and B should have a maximum normal specular reflectance of visible light of 11%.
- All glazing used on Levels 2 to 4 of the northern façade of Building A should also have a maximum normal specular reflectance of visible light of 15%.
- All materials used on the external façade of the development should have maximum normal specular reflectance of visible light of 20%.

It should be noted that the most reflective surface on the façade of a building is the glazing or polished metal surfaces. Reflected solar glare from concrete, brickwork, timber, etc, is negligible (ie: less than 1% normal specular reflectance) and hence will not cause any adverse solar glare effects. Note also that, for any painted or powder-coated metallic surfaces on the exterior façade of the development, the maximum normal specular reflectance of visible light for those types of surfaces is in the range of 1% to 5%, which is well within the aforementioned 20% limit.

Hence, with the incorporation of the abovementioned recommendation, the results of this study indicate that the subject development will not cause adverse solar glare to pedestrians or motorists in the surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity from SEPP65 and the City of Liverpool DCP 2008.

CONTENTS

1 METHODOLOGY

The reflectivity analysis of the subject development has been carried out using the technique published by Hassall (1991). The limiting veiling luminance of 500 candelas per square metre for the comfort of vehicle drivers, as suggested in Hassall (1991), has been adopted as a basis of assessing the glare impact from the subject development. In meeting this criterion for vehicle drivers, conditions will also be satisfactory for pedestrians. The glare impact onto occupants of neighbouring buildings is also discussed in this assessment.

The various critical aspects were determined for the development and are shown in Figure 1. Solar charts for each of these critical aspects are presented in Appendix B, and these are used to derive the check zones which are shown in Figure 2. The check zones highlight the zones that are potentially affected by solar reflections from each critical aspect. It should be noted that the check zones shown in Figure 2 do not take into account the effect of overshadowing by neighbouring buildings or the shielding effect of any existing trees or other obstructions. These effects are examined in the detailed analysis described in Section 2 of this report.

Study point locations are selected within the check zone areas where motorists are facing the general direction of the subject development. These are also shown in Figure 2. For each of the study point locations, photographs have been taken from the viewpoint of motorists using a calibrated camera. Views from the study point locations are presented in Appendix A of this report. A scaled glare protractor has been superimposed over each photograph.

The glare protractor is used to assess the amount of glare likely to be caused and to provide a direct comparison with the criterion of 500 cd/m^2. Alternatively, the glare protractor can be used to determine the maximum acceptable reflectivity index of the façade material of the development for the glare to be within the criterion of 500 cd/m^2.

If it is found that a section of the subject development will be within the zone of sensitive vision of a motorist at a selected study point location (the central area of the glare protractor), the glare protractor is used to determine what the maximum normal specular reflectance of visible light should be for the glazing or any other reflective material used on that section of the façade of the development to ensure that solar glare will not cause discomfort or threaten the safety of motorists or pedestrians, and hence to allow the subject development to comply with the relevant planning control requirements.

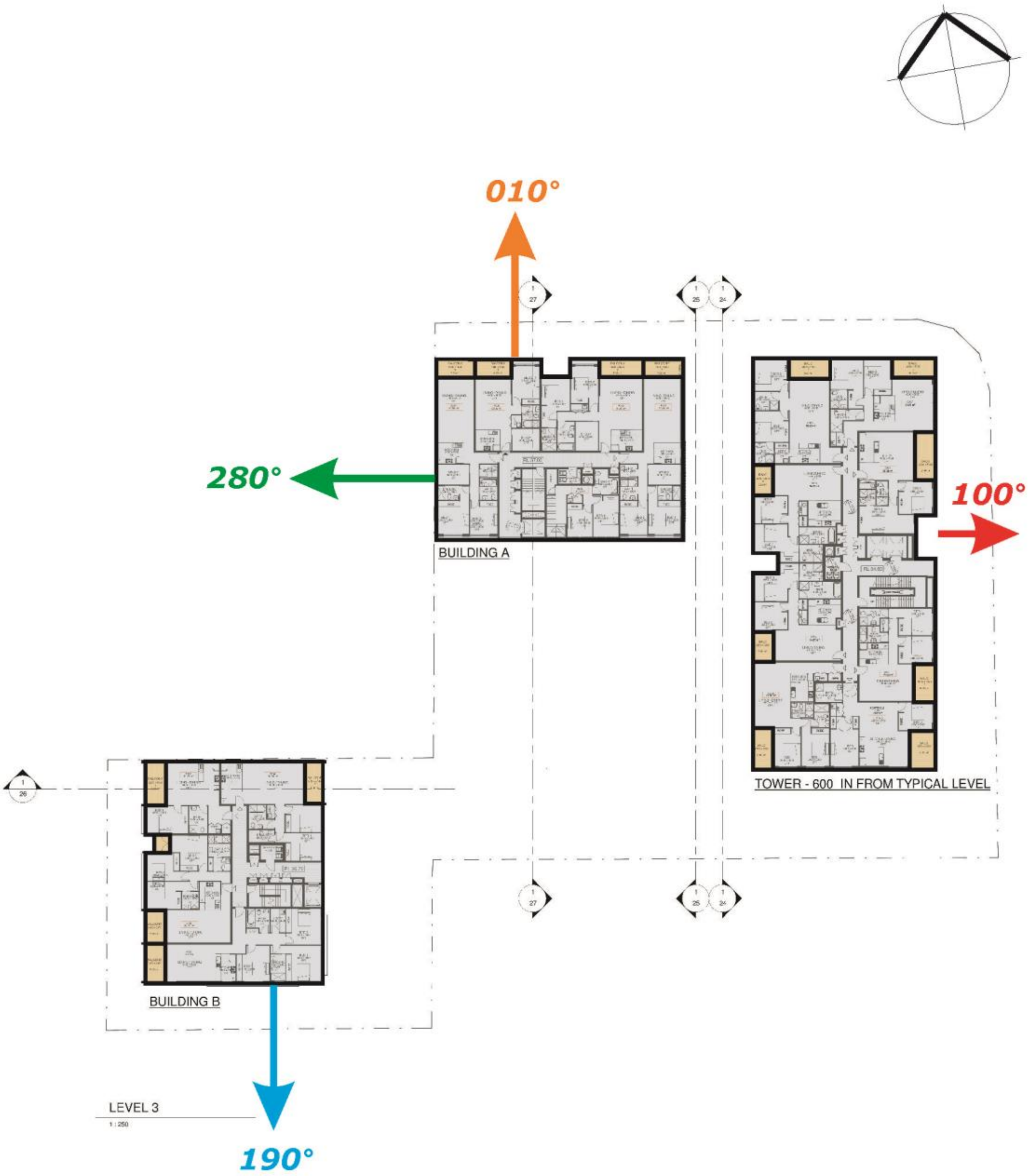

Figure 1: Critical Aspects of the Proposed Development

Figure 2: Check Zones and Layout of Study Points

(the check zones are the areas where glare could potentially be observed)

2 ANALYSIS

2.1 Impact onto Drivers and Pedestrians

From the study of the check zones shown in Figures 2, a total of 8 street level locations have been identified for detailed analysis. A summary of the location of each study point, and the aspects of the subject development could potentially reflect solar glare to each study point location, is shown in Table 1 below. Note that, as mentioned in Section 1, the check zones shown in Figures 2 do not take into account the effect of overshadowing by neighbouring buildings or the shielding effect of any existing trees or other obstructions. These effects are examined in the detailed analysis described in the following sub-sections.

Table 1: Aspects of the Proposed Development that could reflect Solar Glare to each Study Point

Study Point	Location and Viewpoint	Aspect(s) of the Development
1	Hoxton Park Rd, heading east.	Northern and western aspects
2	Hoxton Park Rd, heading east.	Northern and western aspects
3	Pearce St, heading east.	Western and Southern aspects
4	Pearce St, heading east.	Western and Southern aspects
5	Mill Rd, heading west	Eastern aspect
6	Mill Rd, heading west	Eastern aspect
7	Hume Highway, heading north	Southern and eastern aspects
8	Macquarie Street turnoff, heading south	Northern and eastern aspects

2.1.1 Drivers heading east along Hoxton Park Road

Points 1 and 2 are located on Hoxton Park Road to the west of the development, with Point 1 located further from the site than Point 2. These points represent the critical sightline of drivers heading east along Hoxton Park Road at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers at these locations were obtained using a calibrated camera. The photographs have been scaled to enable the glare meter to be overlaid onto these images, as shown in Figures A1 and A2 of Appendix A. The view of the proposed development is also overlaid onto these images.

An analysis of the glare meter overlaid onto the viewpoints at Points 1 and 2 indicates that the northern and western facades of the development will be within the zone of sensitive vision of motorists. However, the angle subtended by the glazing on the northern aspect of Unit 06 will be less than 0.5 degrees due to the implementation of metal louvers and the shallow angle of incidence of the northern façade when the subject development is viewed from Points 1 and 2. Hence, the intensity of glare from the glazing on the northern aspect of Unit 06 will be less than 500 candelas per square metre. However, to ensure that no adverse solar glare is observed by motorists and pedestrians heading east along Hoxton park road at Points 1 and 2, it is recommended that:

- All glazing used on the western façade of the Tower from Level 3 through to Level 23 should have a maximum normal specular reflectance of visible light of 11%.
- The glazing used on the northern façade of Commercial A and Unit 07 from Level 2 through to Level 23 should have a maximum normal specular reflectance of visible light of 11%.
- All glazing used on all levels of the western façade of Buildings A and B should also have a maximum normal specular reflectance of visible light of 11%.
- The glazing used on Levels 2 to 4 of the northern façade of Building A should also have a maximum normal specular reflectance of visible light of 15%.

2.1.2 Drivers heading east along Pearce Street

Points 3 and 4 are located on Pearce Street to the west of the development site, with Point 3 located further from the site than Point 4. These points represent the critical sightline of drivers heading east along Pearce Street at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers at these locations were obtained using a calibrated camera. The photographs have been scaled to enable the glare meter to be overlaid onto these images, as shown in Figures A3 and A4 of Appendix A. The view of the proposed development is also overlaid onto these images.

An analysis of the glare meter overlaid onto the viewpoints at Points 3 and 4 indicates that a small portion of the western aspect of the Tower and both the western and southern aspects of Building B are within the zone of sensitive vision of motorists. Further analysis indicates that the southern aspect subtends an angle of less than 0.5 degrees when viewed from Points 3 and 4. Similarly the western aspect of Building B is only partially visible behind the existing trees and subsequently also subtends an angle of less than 0.5 degrees when viewed from Point 3. Therefore, the intensity of glare from the glazing on these portions of the facade will be less than 500 candelas per square metre. However, to ensure that no adverse solar glare is observed by motorists and pedestrians heading east along Pearce Street at Points 3 and 4, all glazing used on the western façade of the Tower from Level 13 through to Level 20 as well as all glazing use on Level 2 through to Level 6 on the western façade of Building B should have a maximum normal specular reflectance of visible light of 11%.

2.1.3 Drivers heading west along Mill Road

Points 5 and 6 are located on Mill Road to the east of the development site, with Point 5 located further from the site than Point 6. These points represent the critical sightline of drivers heading west along Mill Road at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers at these locations were obtained using a calibrated camera. The photographs have been scaled to enable the glare meter to be overlaid onto these images, as shown in Figures A5 and A6 of Appendix A. The view of the proposed development is also overlaid onto these images.

An analysis of the glare meter overlaid onto the viewpoints at Points 5 and 6 indicates that a portion of the eastern facade of the Tower is within the zone of sensitive vision of motorists. Further investigation indicates that a considerable portion of the eastern façade is covered by metal louvres which provide shading to the recessed glazed façade. However, to ensure that no adverse solar glare is observed by motorists and pedestrians heading west along Mill road at Points 5 and 6, the glazing used for the balustrades and façade which is not shielded by louvres from Level 3 through to Level 23 on the eastern aspect of the facade should have a maximum normal specular reflectance of visible light of 11%. Furthermore all glazing used on the northern end of the eastern façade from Ground Level through to Level 3 should also have a maximum normal specular reflectance of visible light of 11%

2.1.4 Drivers heading north along The Hume Highway

Point 7 is located on The Hume Highway to the south of the development site. This point represents the critical sightline of drivers heading north along The Hume Highway. A site survey of this point has been undertaken, and a photograph showing the viewpoint of drivers at this location was obtained using a calibrated camera. The photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figure A7 of Appendix A. The view of the proposed development is also overlaid onto the image.

An analysis of the glare meter overlaid onto the viewpoint at Point 7 indicates that the subject development will not be within the zone of sensitive vision of motorists. Hence there will be no adverse solar glare observed by motorists or pedestrians heading north along The Hume Highway.

2.1.5 Drivers heading south west whilst turning off Macquarie Street

Point 8 is located on Macquarie Street to the south of the development site. This point represent the critical sightline of drivers south west on the turn off from Macquarie Street. A site survey of this point has been undertaken, and a photograph showing the viewpoint of drivers at this location was obtained using a calibrated camera. The photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figure A7 of Appendix A. The view of the proposed development is also overlaid onto the image.

An analysis of the glare meter overlaid onto the viewpoint at Point 8 indicates that a small portion of the eastern aspect of the main tower will be within the zone of sensitive vision of motorists. However, for this portion which is within the zone of sensitive vision, the majority of the façade is either recessed or shielded by external metal louvres. Hence there will be no adverse solar glare observed by motorists or pedestrians turning off Macquarie Street, heading south west.

2.2 Occupants of Neighbouring Buildings

Our past experience involving more than 250 projects, and also research by Rofail and Dowdle (2004), tends to indicate that Buildings which cause a nuisance to occupants of neighbouring buildings are those that have a normal specular reflectivity of visible light greater than 20%. This seems to justify the suggested limit of 20% reflectivity by many local government authorities and state planning bodies.

Hence a general recommendation is made that all glazing and other reflective materials used on the façade of the subject development have a maximum normal specular reflectivity of visible light of 20% to avoid adverse solar glare to occupants of neighbouring buildings.

2.3 Typical Normal Specular Reflectivity from Building Surfaces

It should be noted that the most reflective surface on the façade of a building is the glazing. Reflected solar glare from concrete, brickwork, timber, etc, is negligible (ie: less than 1% normal specular reflectance) and hence will not cause any adverse solar glare effects. The following sub-sections provide some general reflectance values of more reflective materials used on building facades.

2.3.1 Glazed Surfaces

A glazing supplier will be able to provide information on the maximum normal specular reflectance of visible light of different types of glazing. Some typical reflectivity values of different types of glazing are listed as follows:

- Clear float glass – typically 5% to 8%
- Low-e solar control glazing – typically 8% to 12%
- Other types of compliant performance glazing – up to 20%

2.3.2 Painted and/or Powder-Coated Metallic Surfaces

In the event that some portions of the external façade of the development feature power-coated or painted metallic surfaces, it is not expected that adverse glare will be observed from those surfaces since the maximum normal specular reflectance of visible light of these types of façade materials range from 1% to 5%. This is well within the maximum limits specified in previous sections of this report.

3 CONCLUSION

An analysis has been undertaken to assess the potential for solar glare from the proposed development located at 311 Hume Highway, Liverpool. The analysis has been undertaken based on the architectural drawings prepared by the project architect Design Workshop Australia (DWA), received June, 2015.

This Study assesses compliance with the controls for solar glare from State Environmental Planning Policy No. 65 (SEPP65, Part 04 (Designing the Building) for Amenity), which contains the Apartment Design Guide (ADG). This study also assesses compliance with the planning control requirements of the Liverpool Development Control Plan 2008, which are essentially similar to the controls for solar glare from SEPP65.

The results of the study indicate that, to avoid any adverse glare to drivers and pedestrians on the surrounding streets, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, it is recommended that;

- All glazing used on the western façade of the Tower from Level 3 through to Level 23 should have a maximum normal specular reflectance of visible light of 11%.
- The glazing used for the balustrades and glazed façade which is not shielded by louvres from Ground Level through to Level 23 on the eastern façade of the Tower should have a maximum normal specular reflectance of visible light of 11%.
- All glazing used on the northern façade of Commercial A and Unit 07 from Level 2 through to Level 23 should have a maximum normal specular reflectance of visible light of 11%.
- The glazing used on all levels of the western façade of Buildings A and B should have a maximum normal specular reflectance of visible light of 11%.
- All glazing used on Levels 2 to 4 of the northern façade of Building A should also have a maximum normal specular reflectance of visible light of 15%.
- All materials used on the external façade of the development should have maximum normal specular reflectance of visible light of 20%.

It should be noted that the most reflective surface on the façade of a building is the glazing or polished metal surfaces. Reflected solar glare from concrete, brickwork, timber, etc, is negligible (ie: less than 1% normal specular reflectance) and hence will not cause any adverse solar glare effects. Note also that, for any painted or powder-coated metallic surfaces on the exterior façade of the development, the maximum normal specular reflectance of visible light for those types of surfaces is in the range of 1% to 5%, which is well within the aforementioned 20% limit.

Hence, with the incorporation of the abovementioned recommendation, the results of this study indicate that the subject development will not cause adverse solar glare to pedestrians or motorists in the surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity from SEPP65 and the City of Liverpool DCP 2008.

REFERENCES

Hassall, D.N., “Reflectivity, Dealing with Rogue Solar Reflections”, (published by author), 1991.

Phillips, R.O., “Sunshine and Shade in Australasia”, Sixth Edition, CSIRO Publishing, 1992.

Rofail, A.W., and Dowdle, B., “Reflectivity Impact on Occupants of Neighbouring Properties”, International Conf. on Building Envelope Systems & Technologies, Sydney, 2004.

State Environmental Planning Policy No. 65 (SEPP65), “Apartment Design Guide”, NSW Department of Planning and Environment, 2015.

APPENDIX A - GLARE OVERLAYS FOR THE CRITICAL SIGHT-LINES

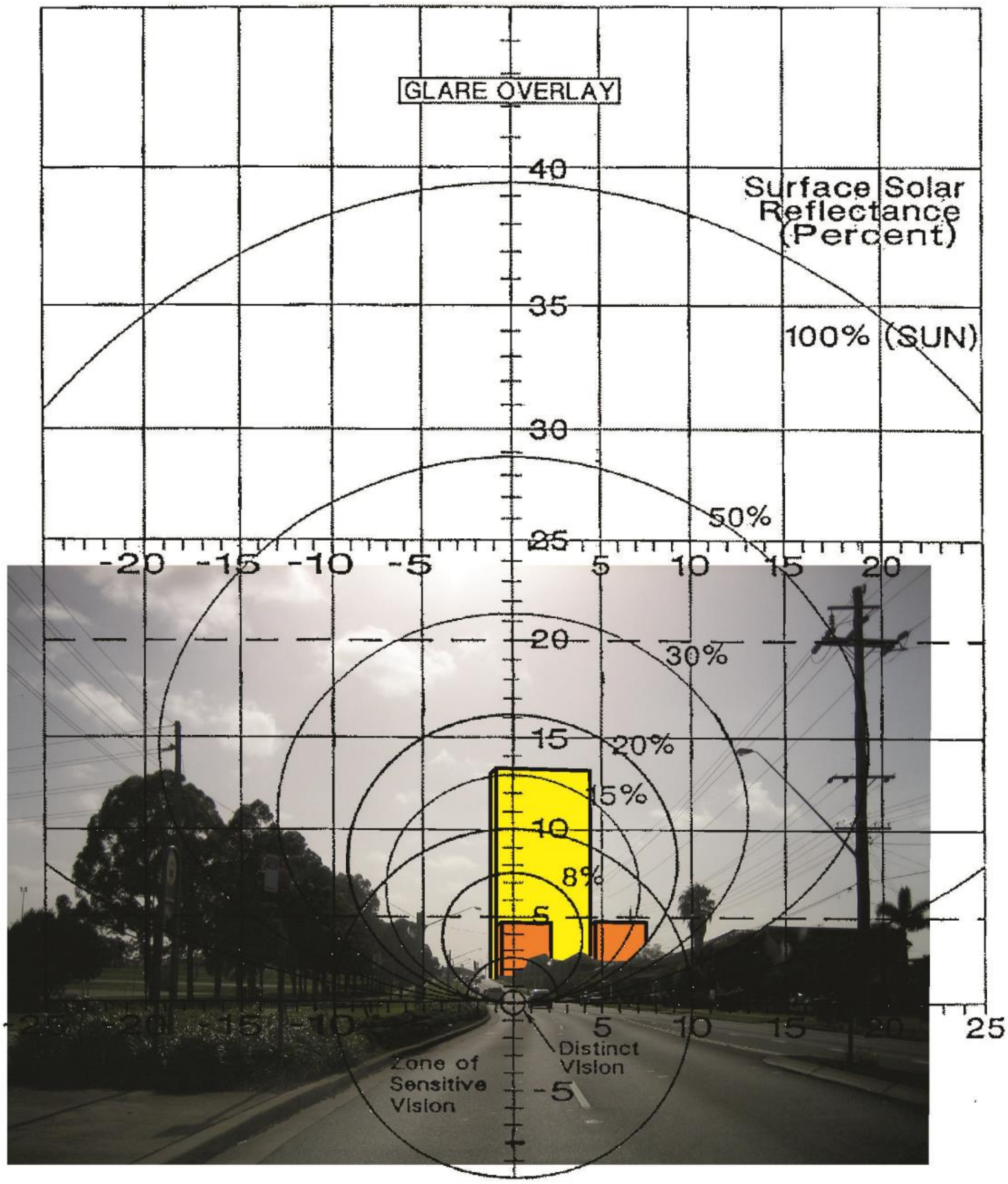

Figure A01: Glare Overlay for Point 1

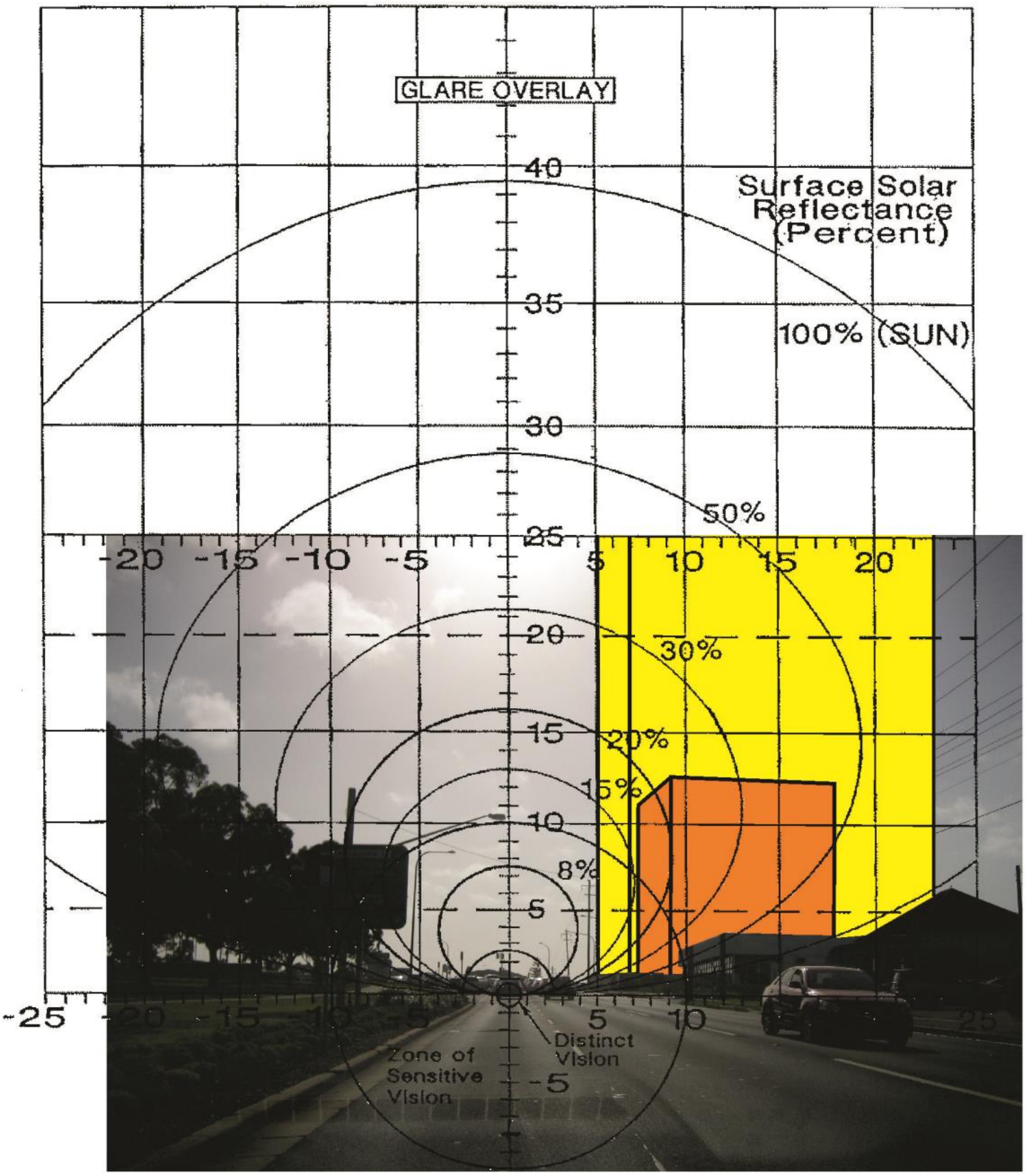

Figure A02: Glare Overlay for Point 2

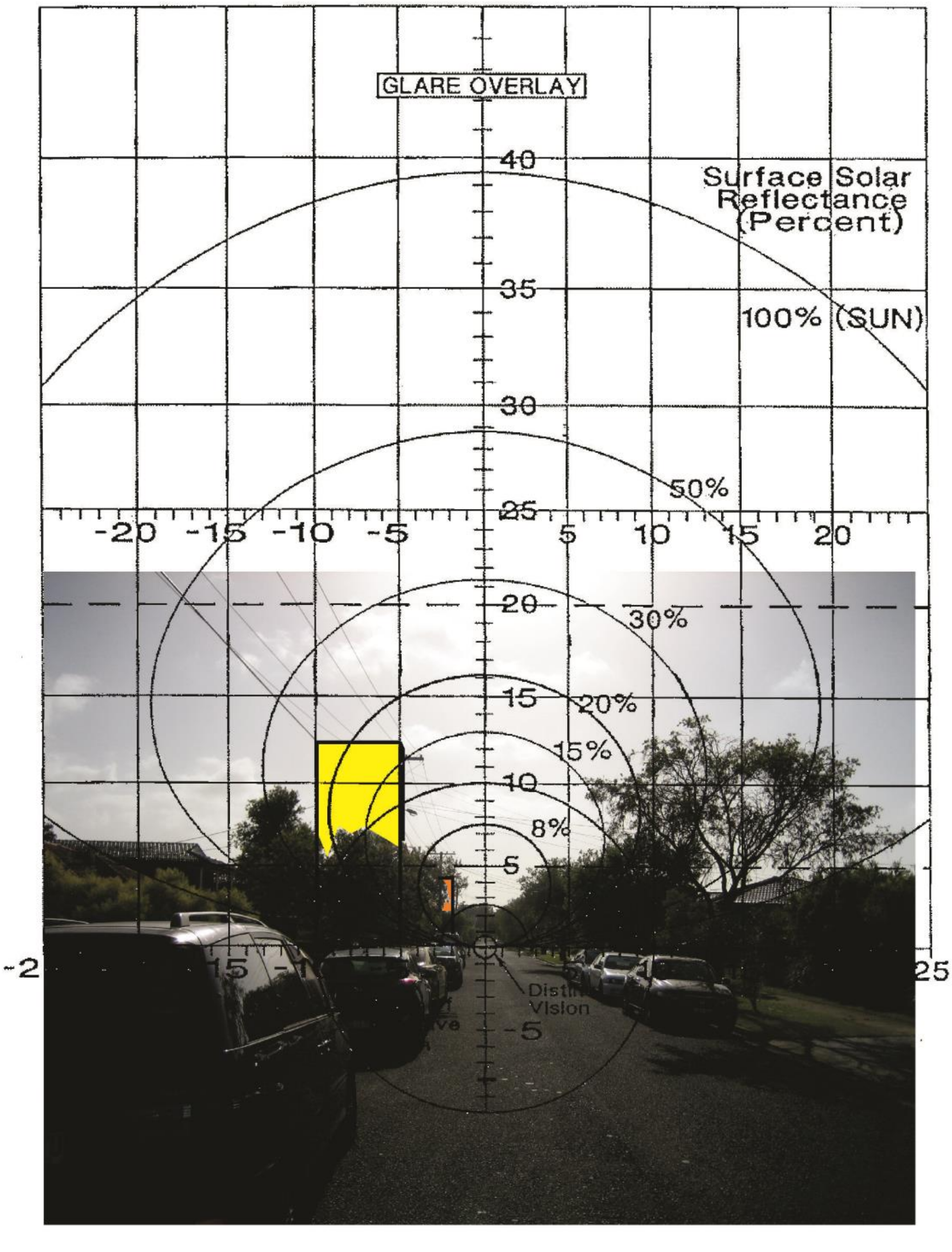

Figure A03: Glare Overlay for Point 3

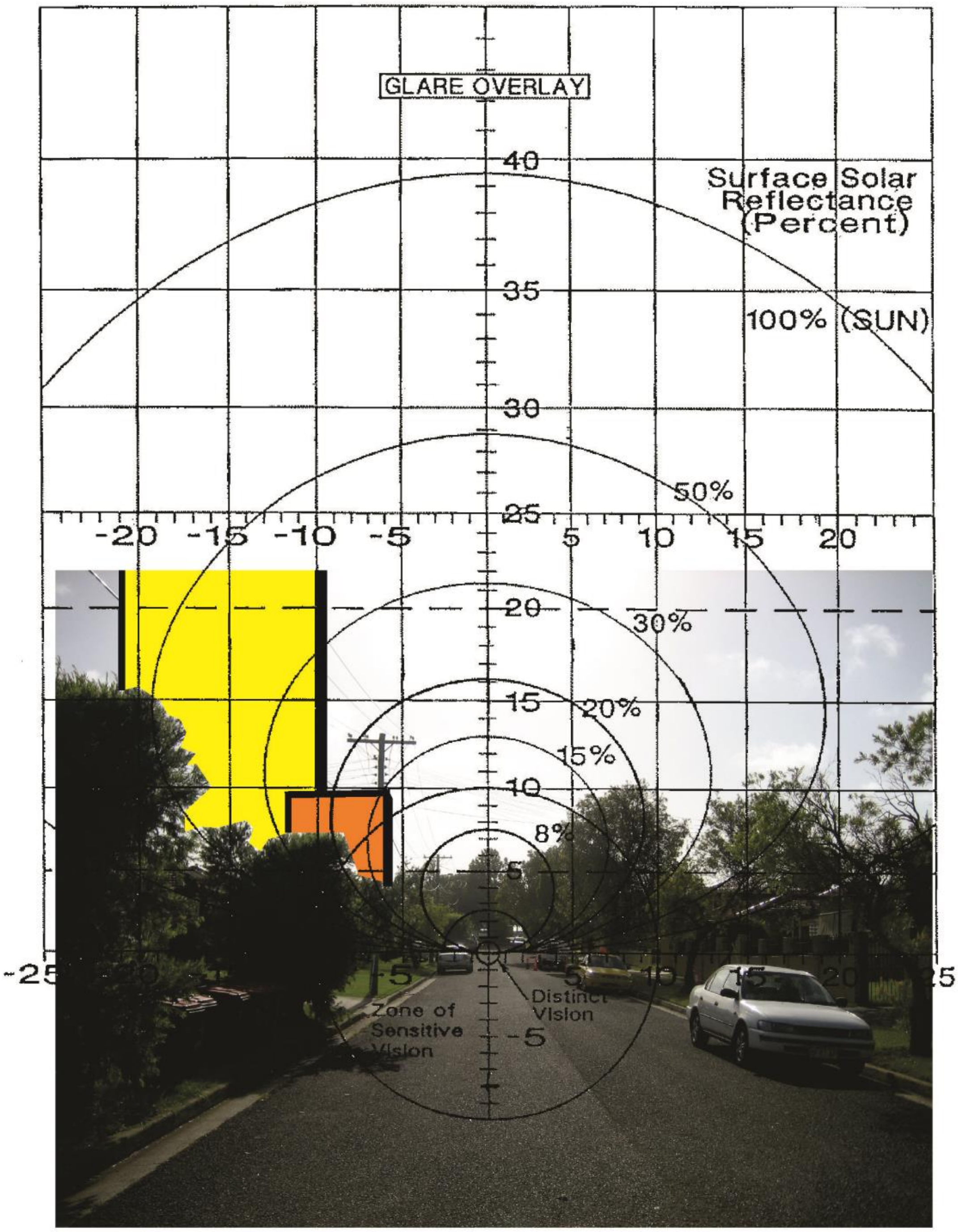

Figure A04: Glare Overlay for Point 4

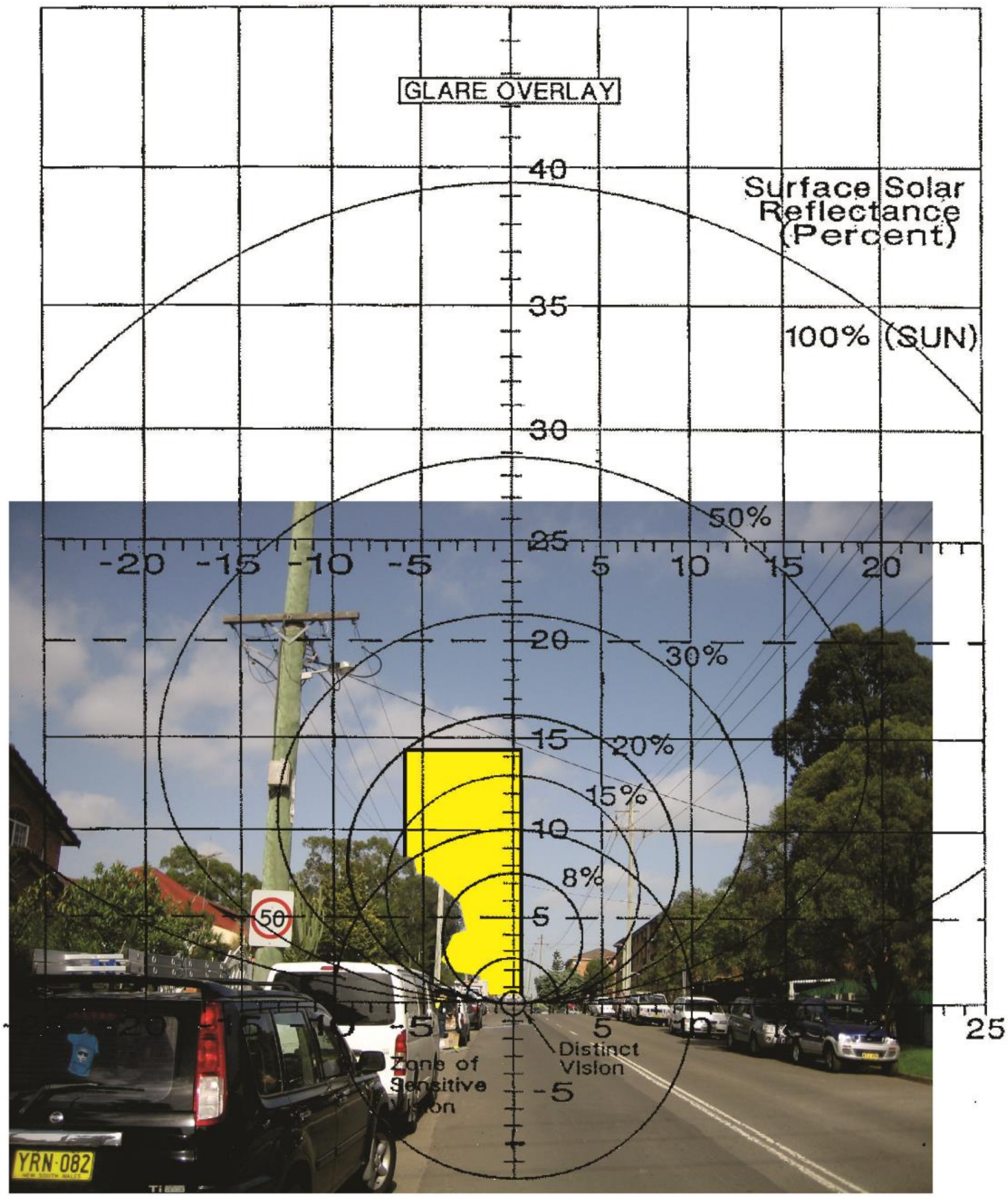

Figure A05: Glare Overlay for Point 5

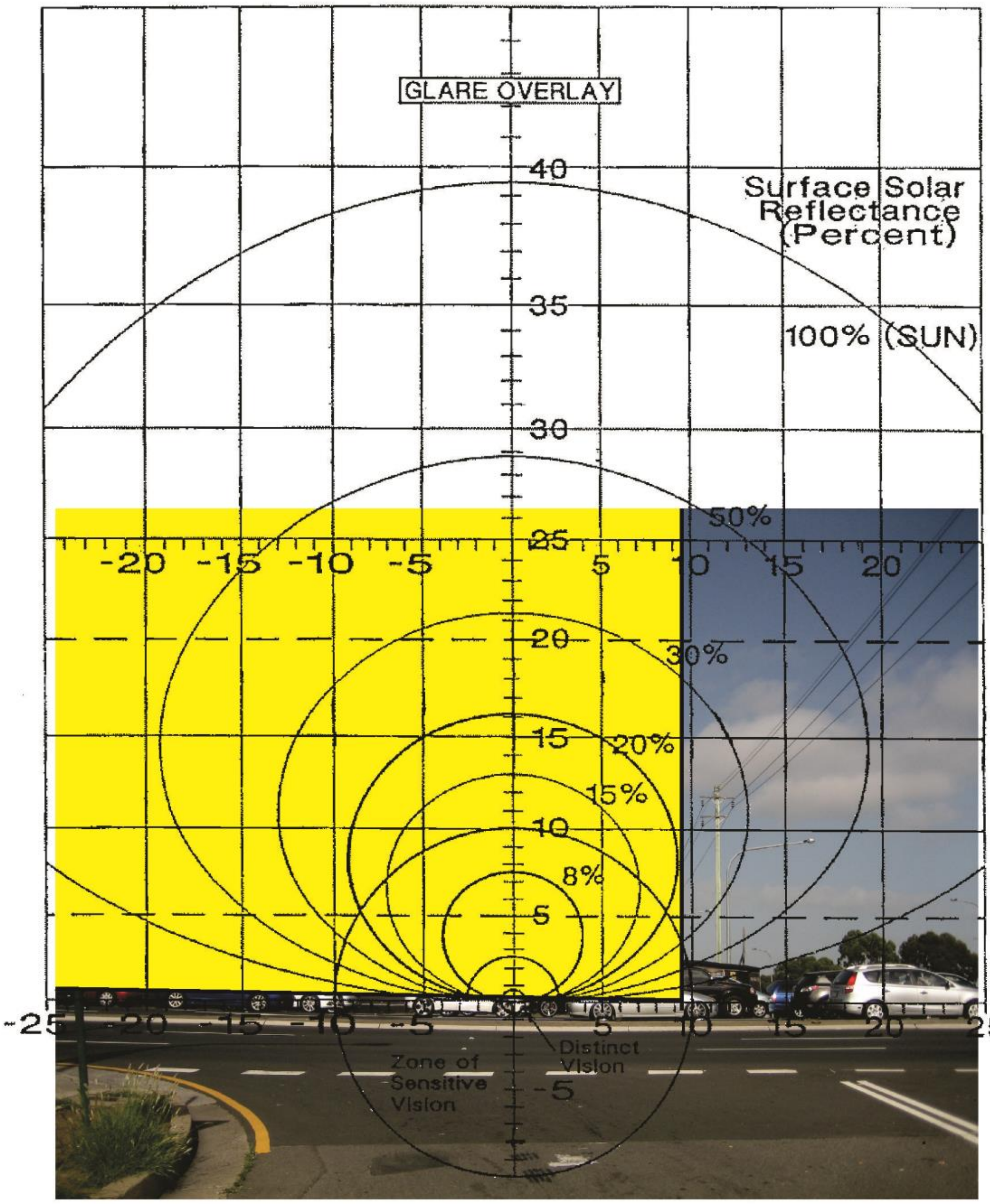

Figure A06: Glare Overlay for Point 6

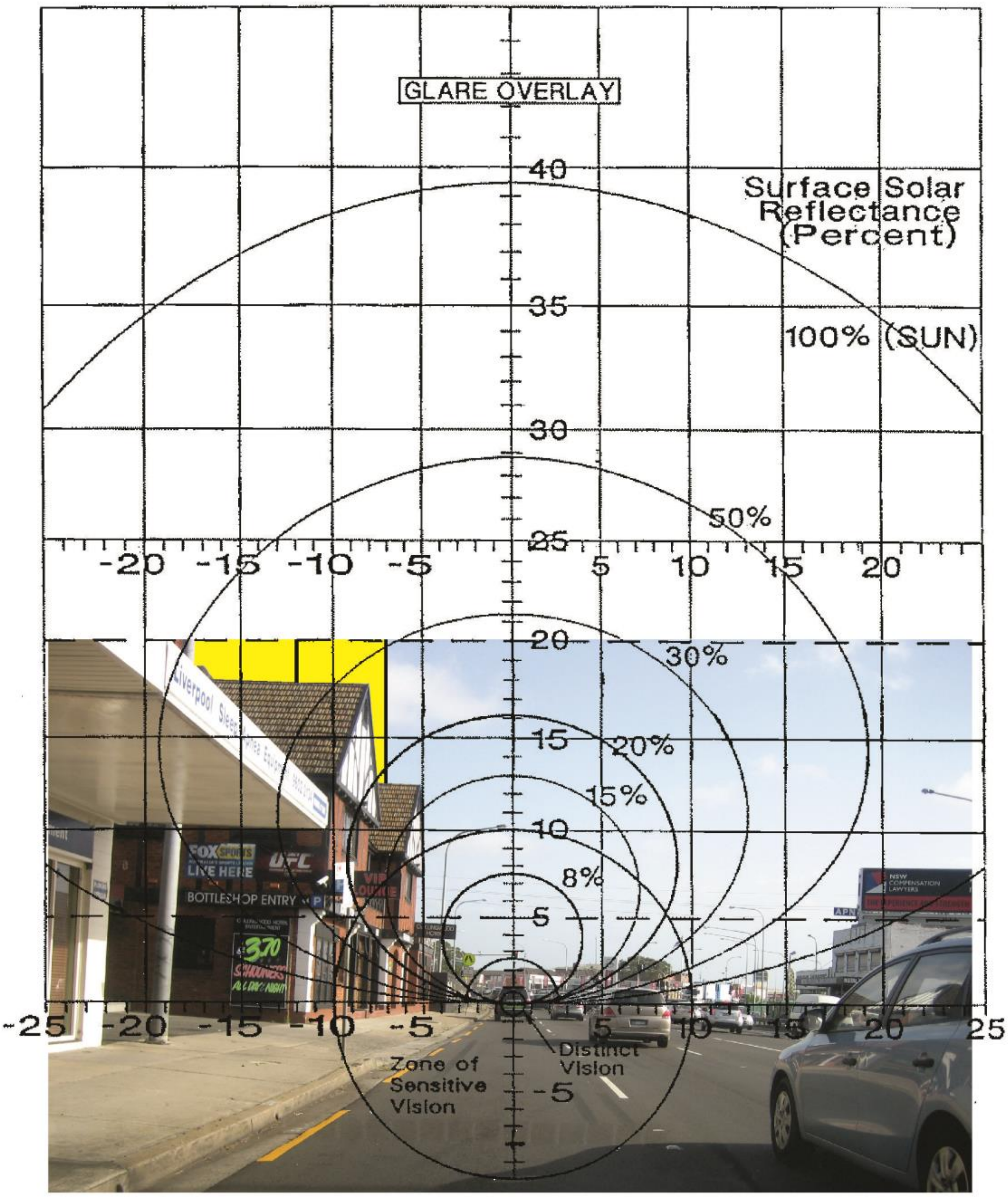

Figure A07: Glare Overlay for Point 7

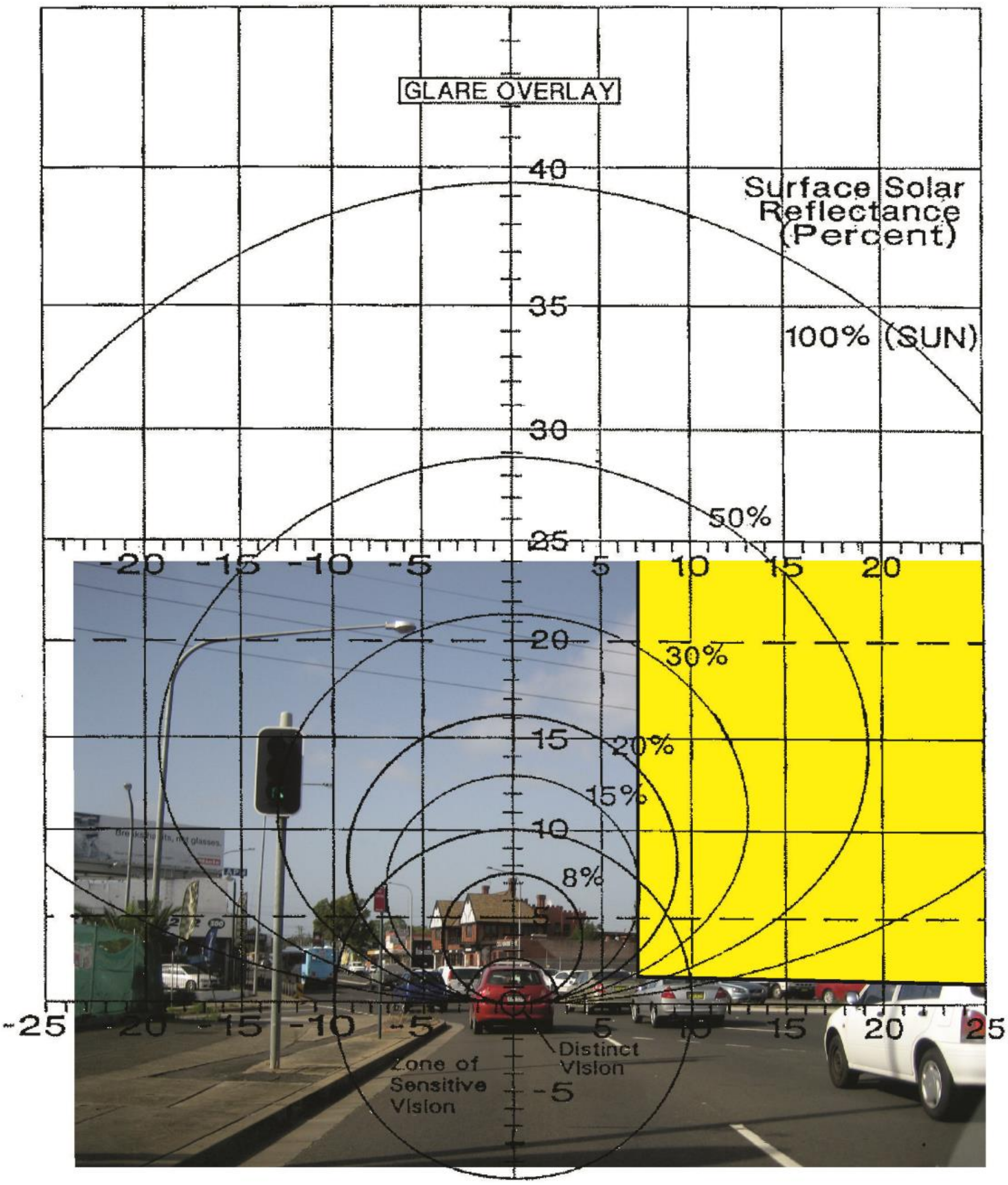

Figure A08: Glare Overlay for Point 8

APPENDIX B - SOLAR CHARTS FOR THE VARIOUS CRITICAL ASPECTS

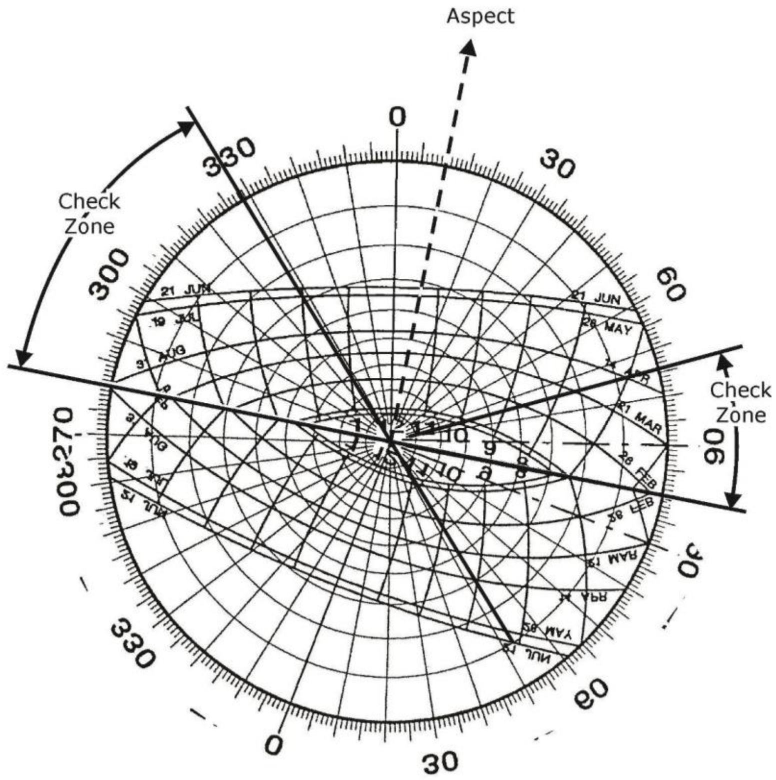

Figure B01: Sun Chart for Aspect 010°

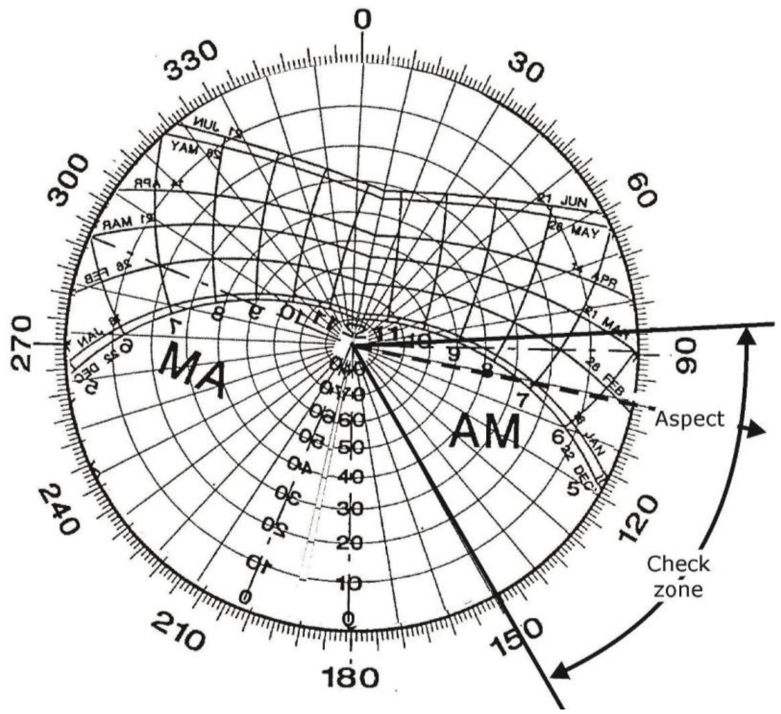

Figure B02: Sun Chart for Aspect 100°

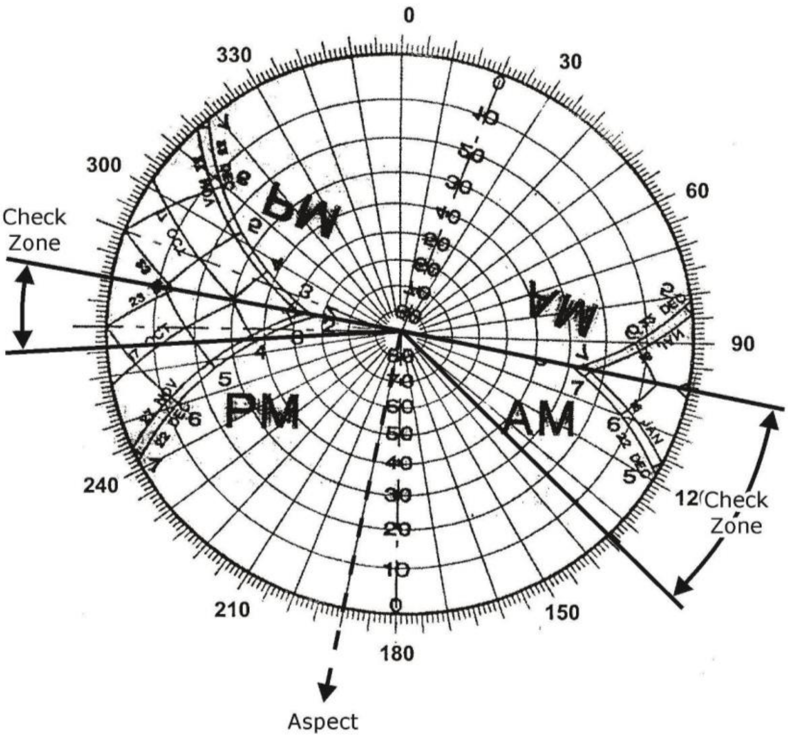

Figure B03: Sun Chart for Aspect 190°

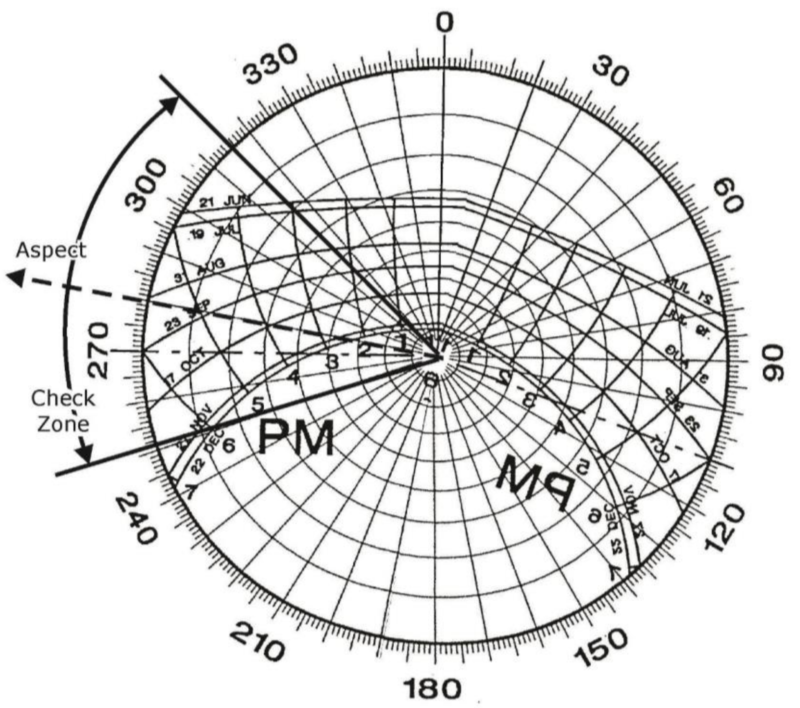

Figure B04: Sun Chart for Aspect 280°

APPENDIX C - STANDARD SUN CHART FOR THE SYDNEY REGION

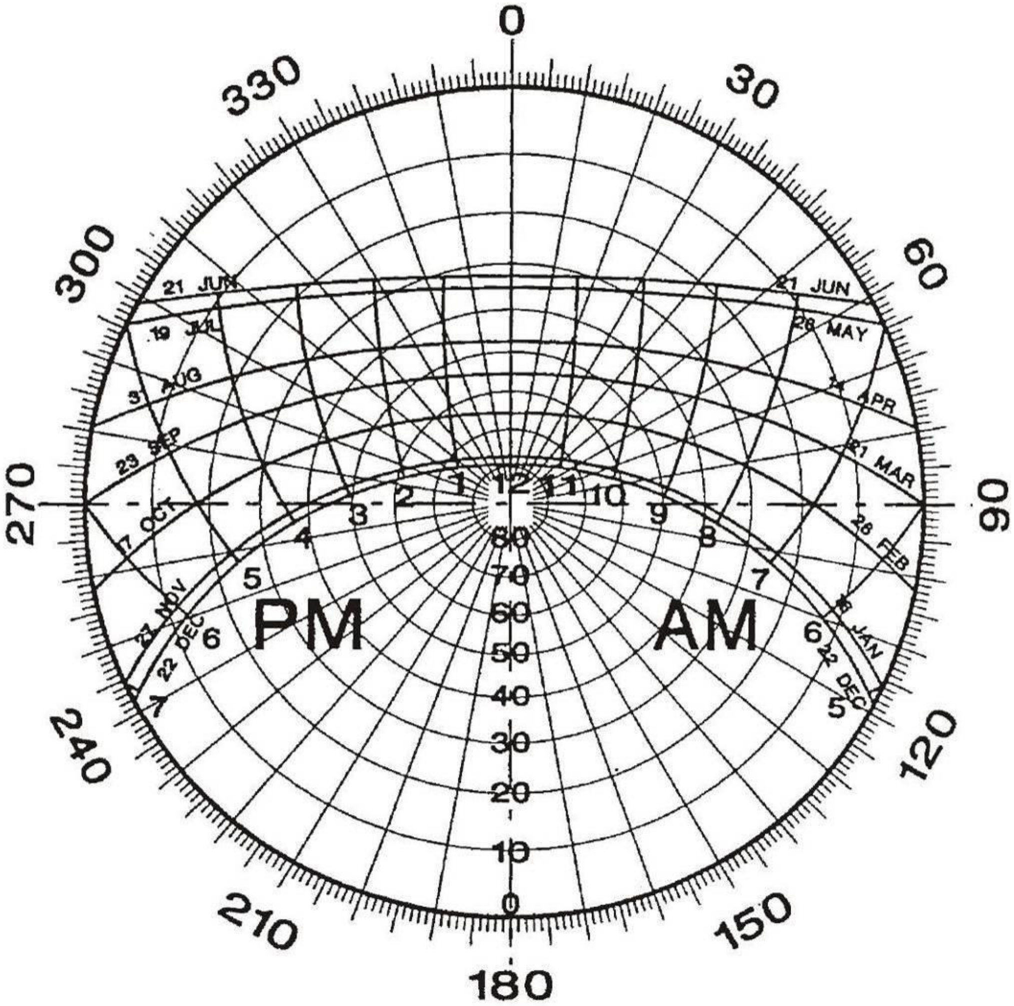

Figure C1: Standard Sun Chart for Sydney Region