Appendix S

Solar reflectivity analysis

Windtech

Solar Light Reflectivity Analysis

for the proposed Stage 2a City East Zone Substation and Integrated Commercial Development at

33 Bligh Street, Sydney

August 25, 2011

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Document Control

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Appendix A: Glare Overlays from the Various Study Locations

Appendix B: Solar Charts for the Various Aspects of the Proposal

1.0 Introduction

This study is to investigate the potential impact of solar glare from the proposed Stage 2a City East Zone Substation and Integrated Commercial Development at 33 Bligh Street, Sydney. The site is located within the Sydney CBD and is bounded by Bligh Street to the south-east and O'Connell Street to the north-west. An analysis has been undertaken, based on architectural drawings received August 25 2011, prepared by Kann Finch Group, dated August 19, 2010 and by Fitzpatrick and Partners, dated August 22, 2011.

The proposed development consists of an integrated Energy Australia zone substation in the basement, a podium section primarily comprised of mechanical and plant rooms, and a rectangular-plan office building above. The proposed development is approximately 31 storeys high above the O'Connell Street ground floor level. Balconies are not proposed for the office tower, and hence the façade of the tower will be flat.

With regards to solar reflectivity, this study addresses the requirement of the October 2003 City of Sydney DCP, which states under Section 4.5: Reflectivity;

4.5.1 New buildings and facades should not result in glare that causes discomfort or threatens safety of pedestrians or drivers.

4.5.2 Visible light reflectivity from building materials used on the facades of new buildings should not exceed 20%.

4.5.3 A Reflectivity Report that analyses the potential solar glare from the proposed new development on pedestrians or motorists may be required.

A reflectivity analysis of the subject development has been carried out using the technique published by Mr David N. H. Hassall (1991)[1].

The limiting veiling luminance of 500 candelas per square metre for the comfort of vehicle drivers, 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.

A figure showing the site location is presented in Figure 1. The various aspects of the proposal are presented on Figure 2.

[1] D.N. Hassall, 1991, Reflectivity, Dealing with Rogue Solar Reflections (published by author)

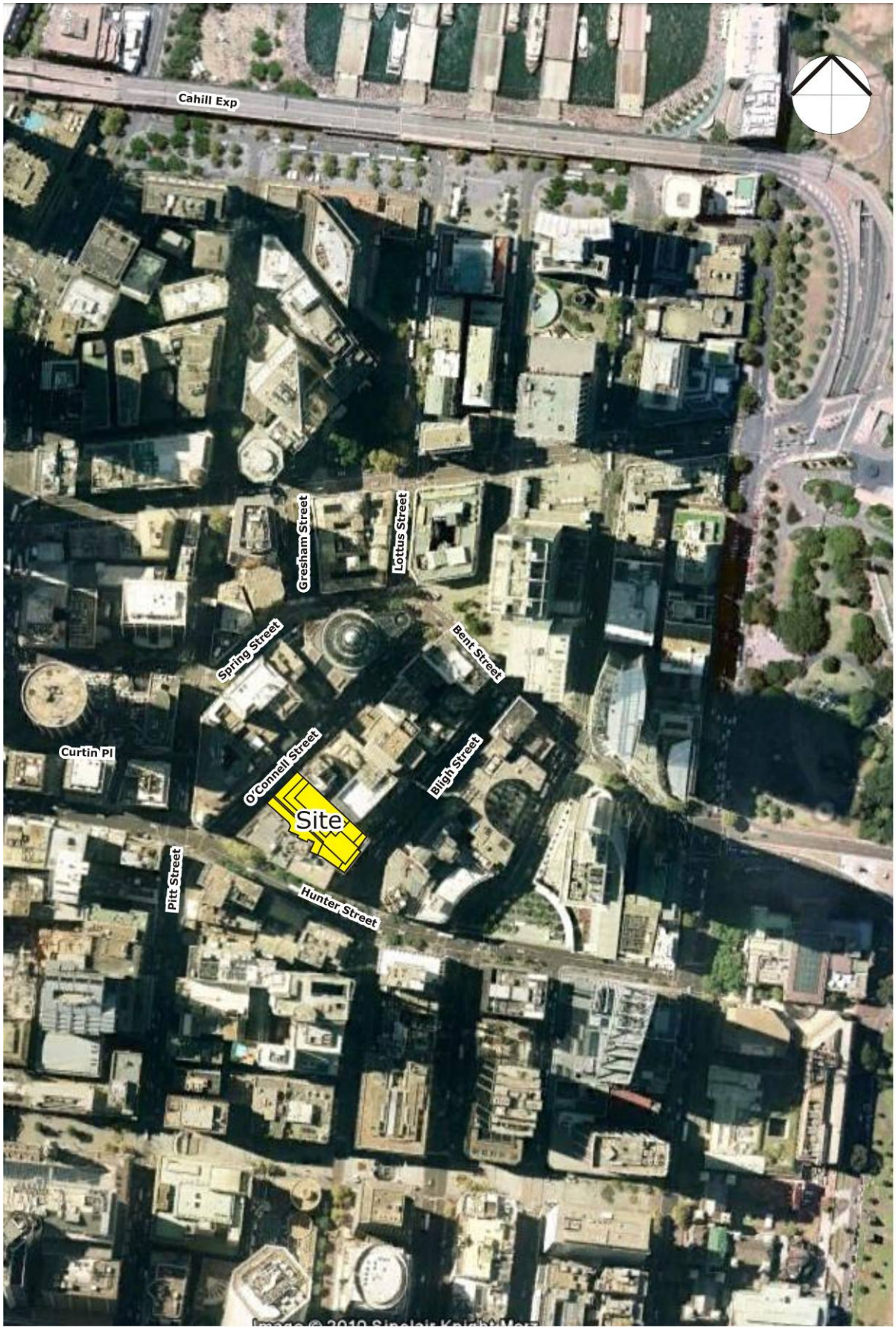

Figure 1: Aerial Image of the Proposed Development Site

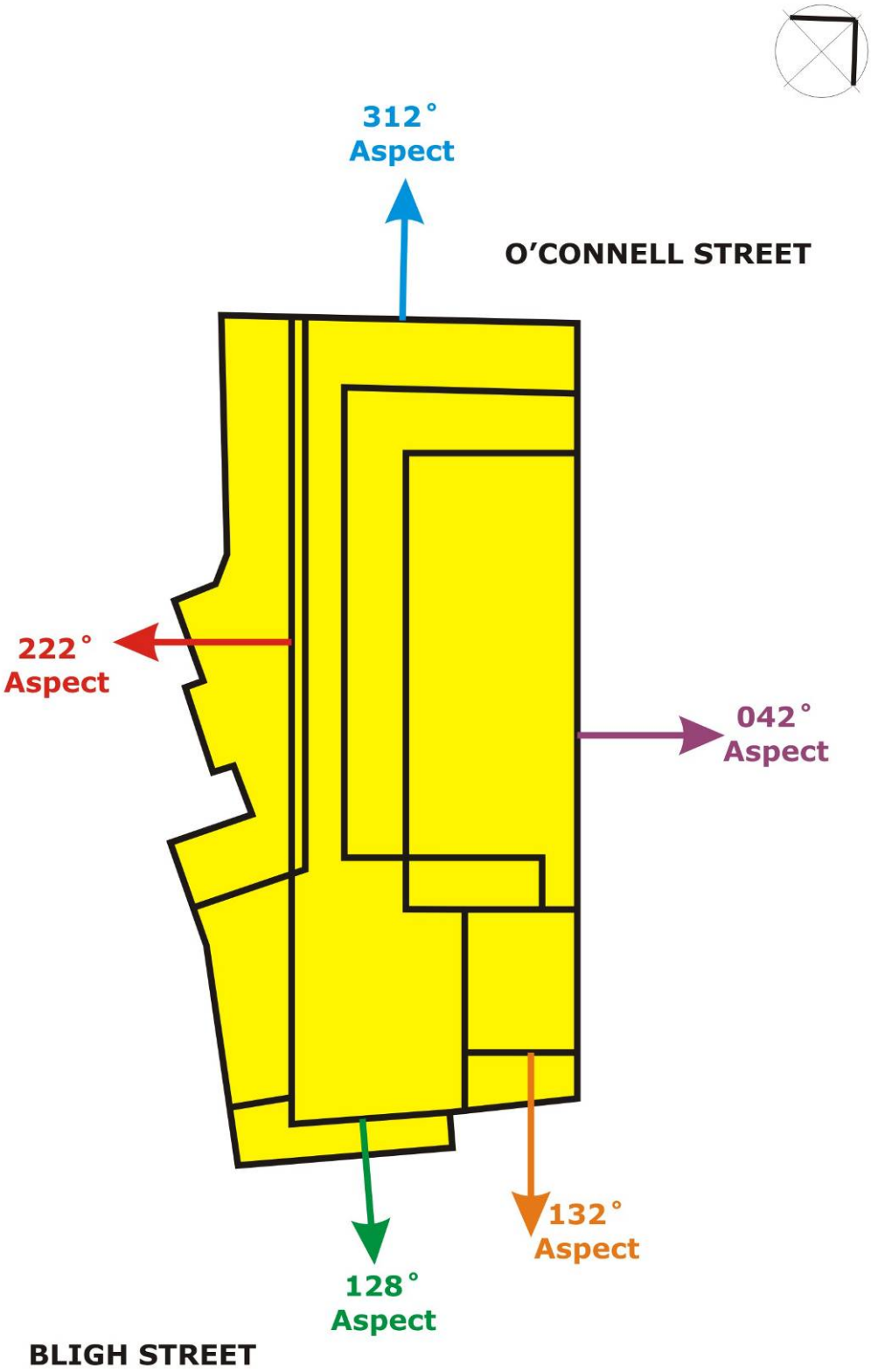

Figure 2: The Critical Aspects of the Proposed Development

2.0 Analysis

Solar charts for the various aspects of the development are presented in Appendix B. Check zones for the selected aspects have also been identified based on the data obtained from the solar charts. The check zones highlight the zones that are potentially affected by solar reflections from each aspect. The various check zones for the subject development are described in Figure 3.

It should be noted that the check zones described in Figure 3 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 in the following Section 2.1 and subsequent subsections of this report.

2.1 Impact onto Drivers and Pedestrians

From the study of the check zones and with consideration of the potential overshadowing effects of neighbouring buildings, 8 street level locations have been identified for analysis. These locations are indicated in Figure 3. Table 1 summarises the effect of the various aspects on the selected study locations.

Table 1: Aspects of the Site that affect each of the Study Points

Study Point	Aspects
Point 1	042˚ and 312˚ aspects
Point 2	042˚ and 312˚ aspects
Point 3	042˚ and 312˚ aspects
Point 4	042˚ aspect
Point 5	042˚ aspect
Point 6	042˚ aspect
Point 7	222˚ aspect
Point 8	128˚ and 132˚ aspects

For each of the study point locations, photographs have been taken from the viewpoint of drivers and pedestrians 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 candelas per square metre. Alternatively, the glare protractor can be used to determine the maximum acceptable reflectivity index for the glare to be within the criterion of 500 candelas/m^2.

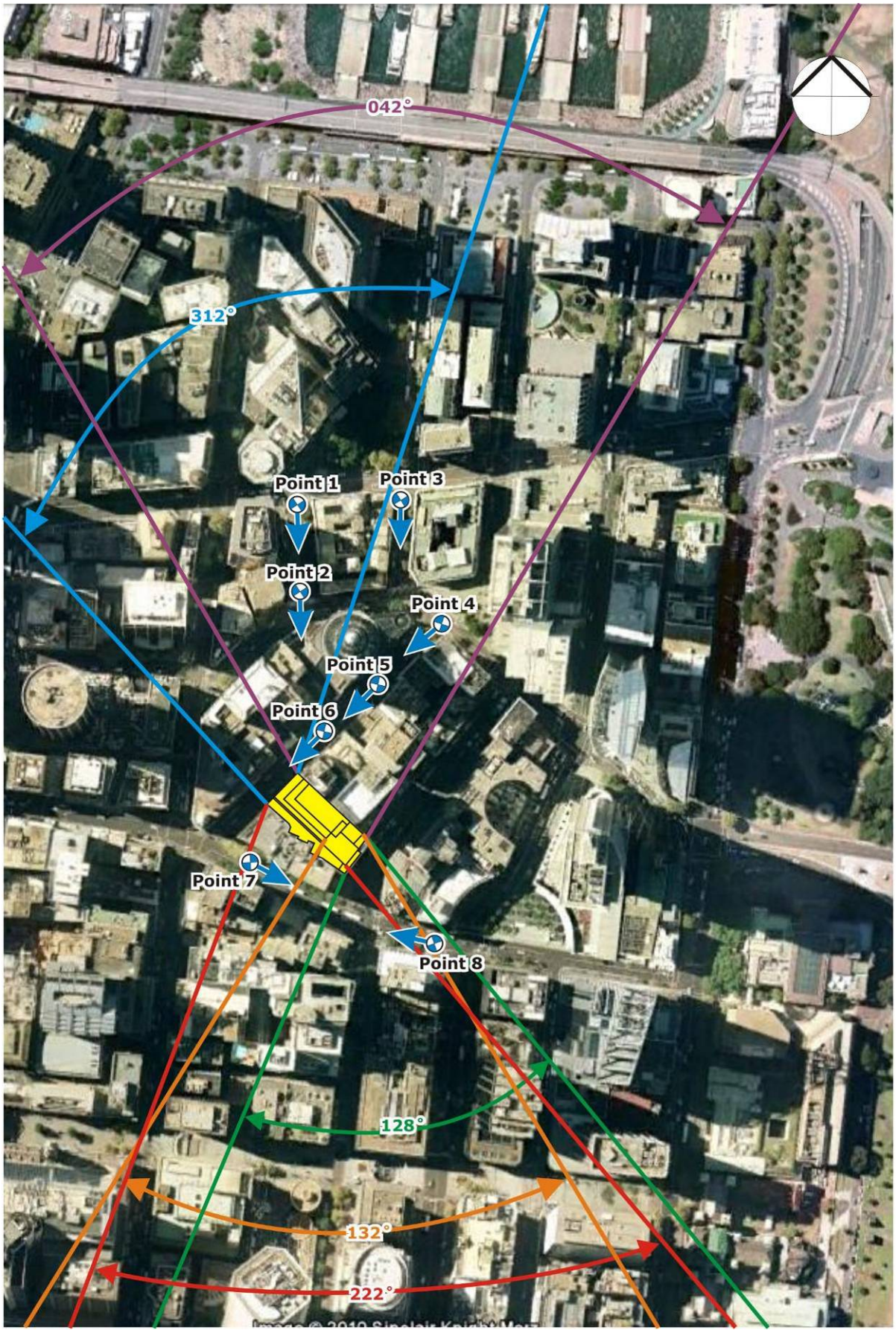

Figure 3: Check Zones and Layout of Study Points

2.1.1 Gresham Street Study Point Locations

Points 1 and 2 are located to the north of the proposed development site, on Gresham Street. These points represent critical sightlines of drivers heading south along Gresham Street. These points are located within the check zones for the 042˚ and 312˚ aspects of the proposed development.

The site survey of these points, shown in Figure A1 and A2 of Appendix A, indicate that the view of the proposed development is obscured by the existing building to the north of the proposed development.

Hence there will be no adverse glare from the 042˚ and 312˚ aspects of the proposed development to drivers and pedestrians facing south along Gresham Street at Points 1 and 2.

2.1.2 Loftus Street Study Point Location

Point 3 is located to the north of the proposed development on Loftus Street. This point represents a critical sightline of drivers heading south along Loftus Street at this location. This point is located within the check zones for the 042˚ and 312˚ aspects of the proposed development.

The site survey of this point, shown in Figure A3 of Appendix A, indicates that the view of the proposed development is obscured by the existing building north-east of the proposed development.

Hence there will be no adverse glare from the 042˚ and 312˚ aspects of the proposed development to drivers and pedestrians facing south along Loftus Street at Point 3.

2.1.3 O'Connell Street Study Point Locations

Points 4, 5 and 6 are located to the north-east of the proposed development site on O'Connell Street. These points represent critical sightlines of drivers heading south-west along O'Connell Street. These points are located within the check zone for the 042˚ aspect of the proposed development.

The site survey of these points, shown in Figures A4, A5 and A6 of Appendix A, indicates that the 312˚ aspect of the proposed development fall within the zone of sensitive vision for drivers and pedestrians facing south-west at these locations. However, they are not within the check zone for 042˚ aspect.

Hence there will be no adverse glare from the 042˚ aspect to drivers and pedestrians facing south-west along O'Connell Street at Points 4, 5 and 6.

2.1.4 Hunter Street Study Point Location (for east-bound drivers)

Point 7 is located to the west of the proposed development site, on Hunter Street. This point represents a critical sightline of drivers heading east along Hunter Street at this location. This point is located within the check zone for the 222˚ aspect of the proposed development.

The site survey of this point, shown in Figure A7 of Appendix A, indicates that the view of the proposed development is obscured by the existing building south of the site.

Hence there will be no adverse glare from the 222˚ aspect to drivers and pedestrians facing east along Hunter Street at Point 7.

2.1.5 Hunter Street Study Point Location (for west-bound drivers)

Point 8 is located to the east of the proposed development, on Hunter Street. This point represents a critical sightline of drivers heading west along Hunter Street at this location. This point is located within the check zone for the 128˚ and 132˚ aspects of the proposed development.

The site survey of this point, shown in Figure A8 of Appendix A, indicates that the view of the proposed development is obscured by the existing building south-east of the site.

Hence there will be no adverse glare from the 128˚ and 132˚ aspects to drivers and pedestrians facing west along Hunter Street at Point 8

2.2 Impact onto Occupants of Neighbouring Buildings

More research is required to properly assess what is considered an acceptable level of veiling luminance to occupants of surrounding buildings. Rofail and Dowdle (2004)[2] have highlighted the subjectivity of glare impact to occupants of surrounding buildings as it is highly affected by a number of factors, some of these are listed below:

- the intensity of glare
- duration of glare impact
- the type of use of the building
- the type of glazing used on the neighbouring building (eg. Clear or Tinted)
- shading elements on the façade of the neighbouring building
- level of tolerance by the occupant of the neighbouring building

Our past experience, involving approximately 200 projects, tends to indicate that buildings that tend to cause 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. This reflectivity is defined as the level of luminance or normal specular reflectivity of visible light.

Hence, a general recommendation is made that all glazing used on the facades of the development have a normal specular reflectivity of visible light of 20 percent or less to avoid adverse solar glare to occupants of neighbouring buildings.

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

3.0 Conclusion

A reflectivity analysis of the proposed Stage 2a City East Zone Substation and Integrated Commercial Development at 33 Bligh Street, Sydney, has been carried out using the technique published by Mr David N. H. Hassall.

The results of the study indicate that to avoid any adverse glare to drivers and pedestrians on the surrounding streets and associated outdoor areas of the proposed development site, and to comply with the October 2003 City of Sydney DCP, Section 4.5, it is recommended that all areas of the façade of the development should have a maximum normal specular reflectivity of visible light of 20 percent. No additional requirement is needed to satisfy the comfort criterion for driver visibility.

With the aforementioned recommendation satisfied, the results of this analysis indicate that the proposed development will not cause adverse solar glare to drivers or pedestrians in any of the surrounding streets and other outdoor areas. It is also expected that no adverse glare impacts will result with regards to the occupants of neighbouring buildings if the glazing type(s) selected for the external facades of the development have a normal specular reflectivity of visible light of 20 percent or less. Other highly reflective materials should also be avoided on the façades to avoid adverse glare to the occupants of neighbouring buildings.

Appendix A

Analysis of Sight-Lines from the Various Study Locations

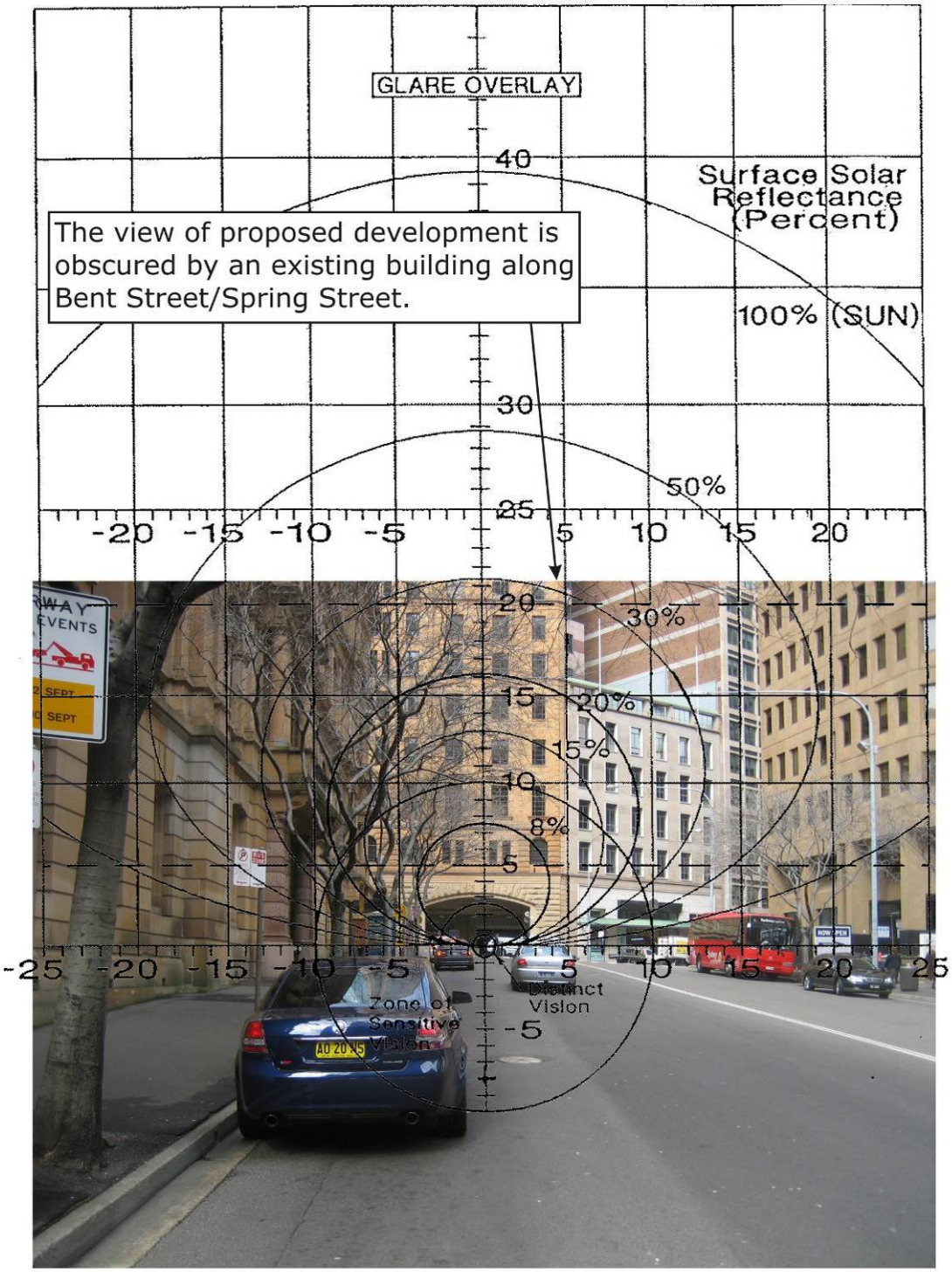

Figure A1: Glare Overlay for Point 1

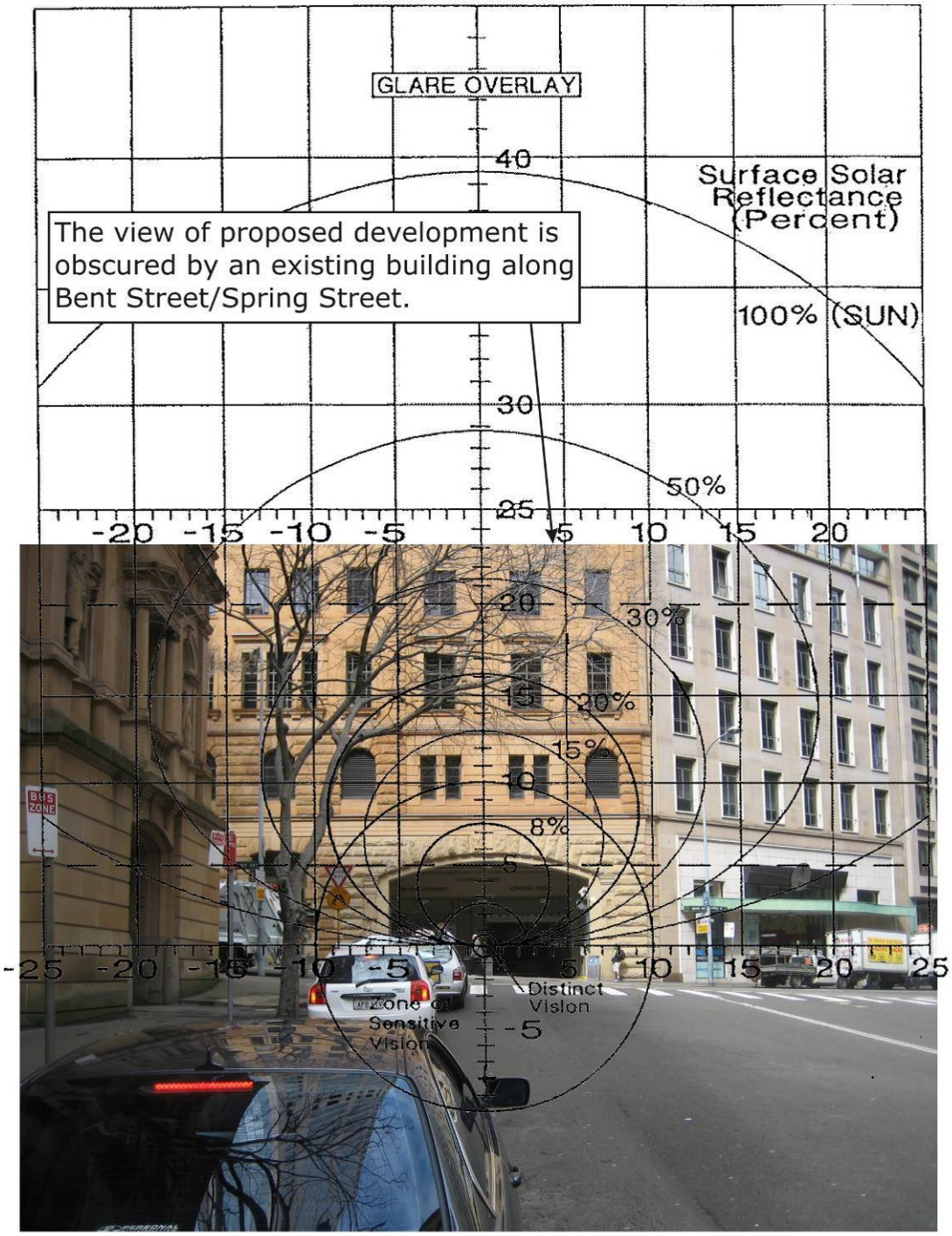

Figure A2: Glare Overlay for Point 2

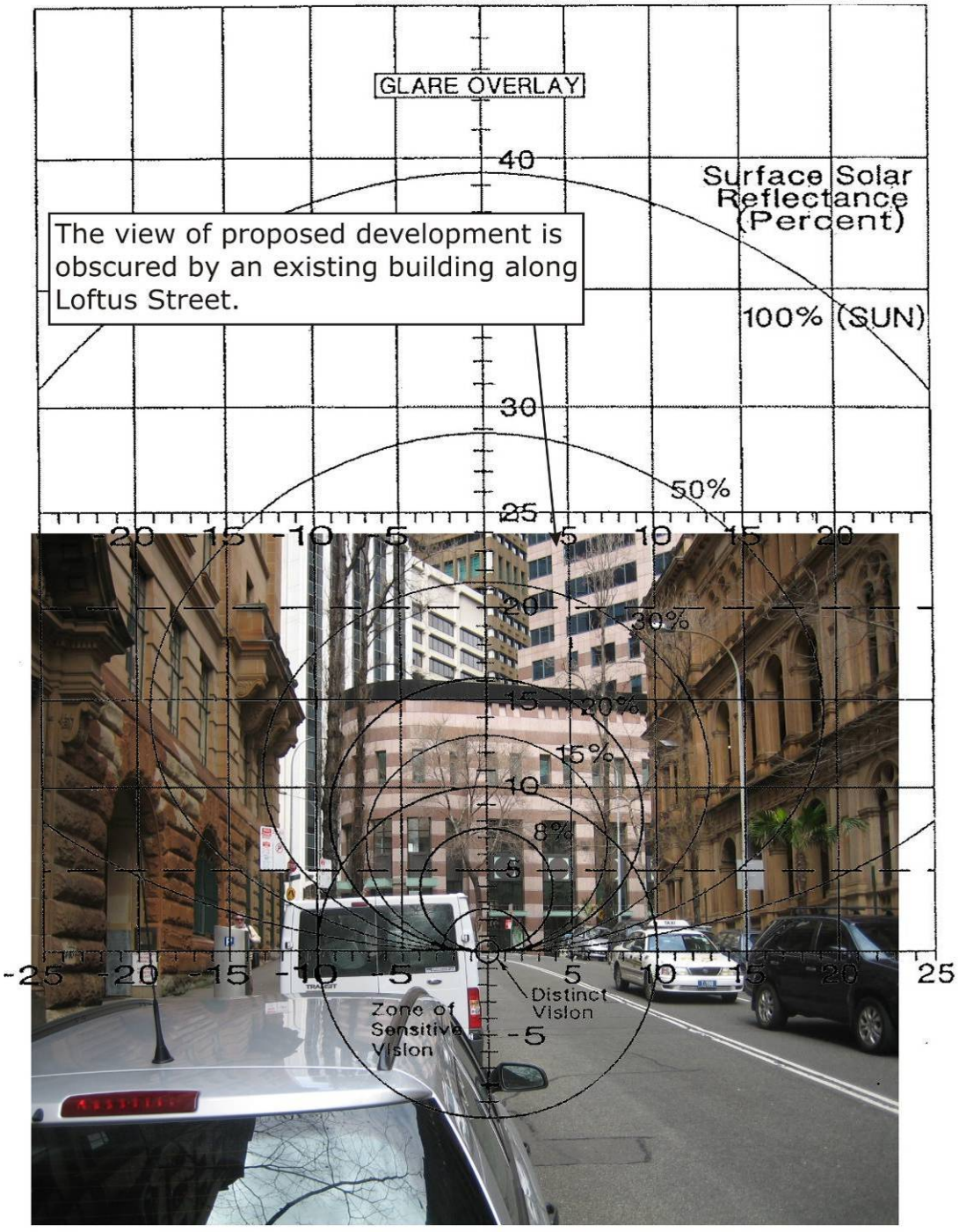

Figure A3: Glare Overlay for Point 3

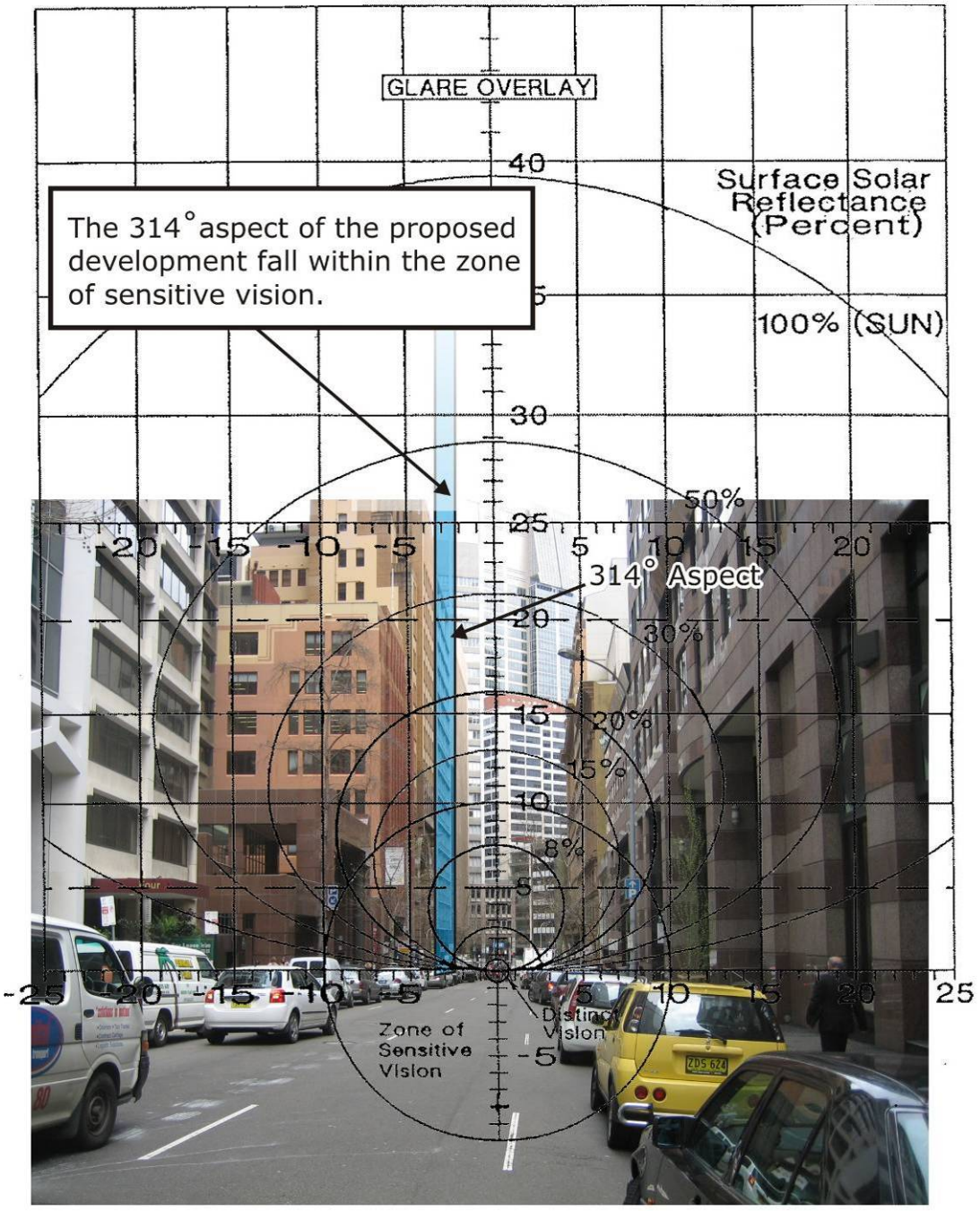

Figure A4: Glare Overlay for Point 4

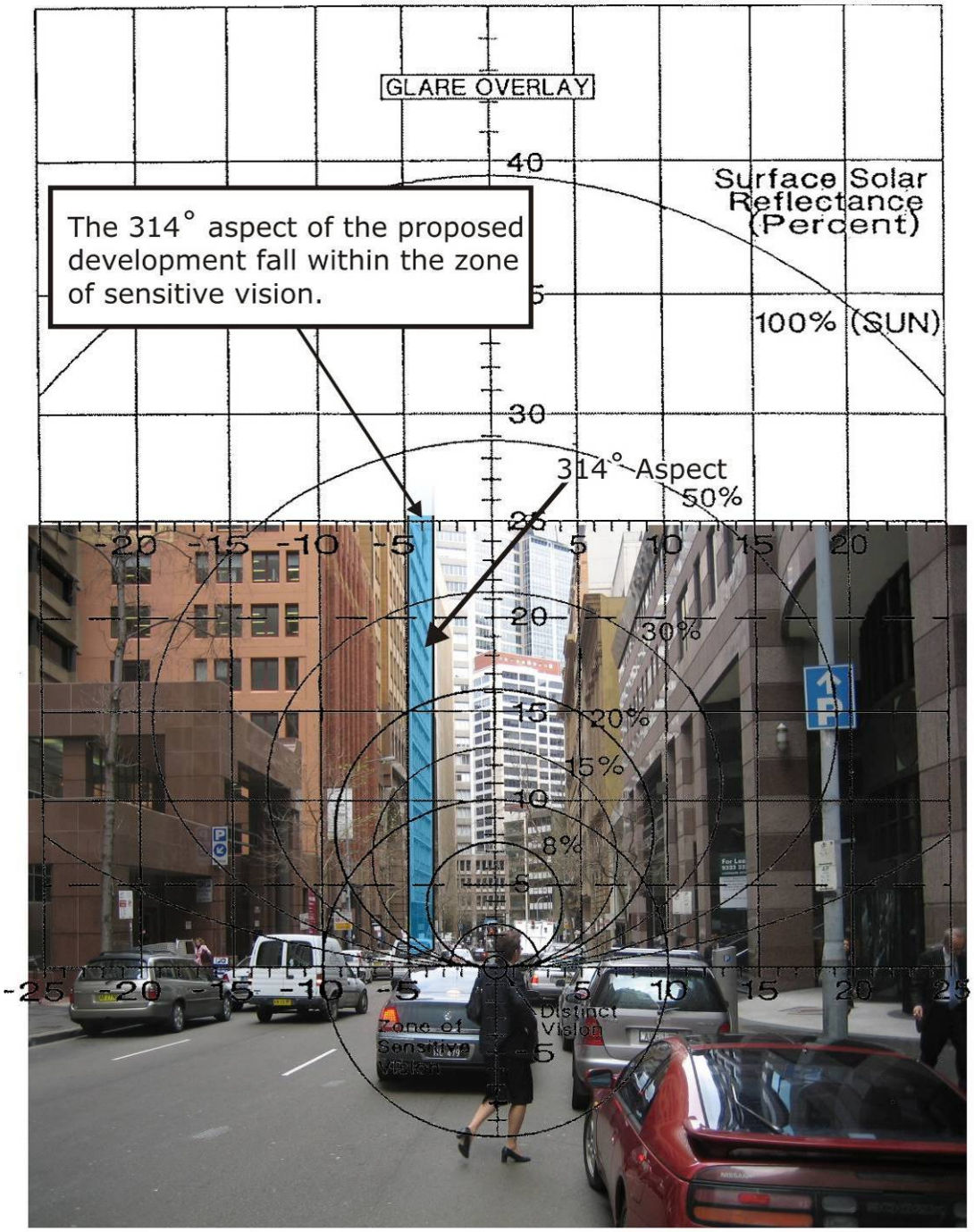

Figure A5: Glare Overlay for Point 5

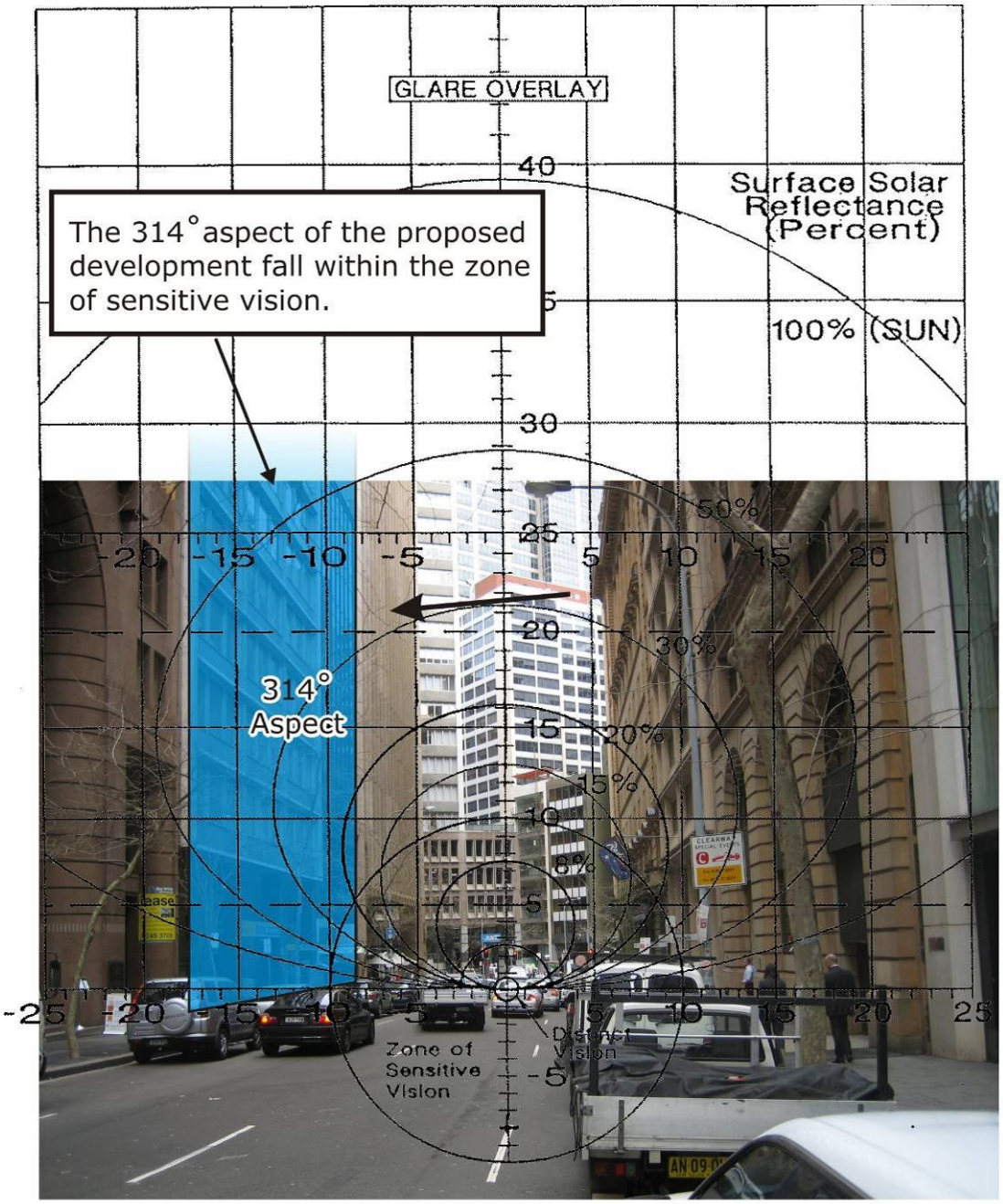

Figure A6: Glare Overlay for Point 6

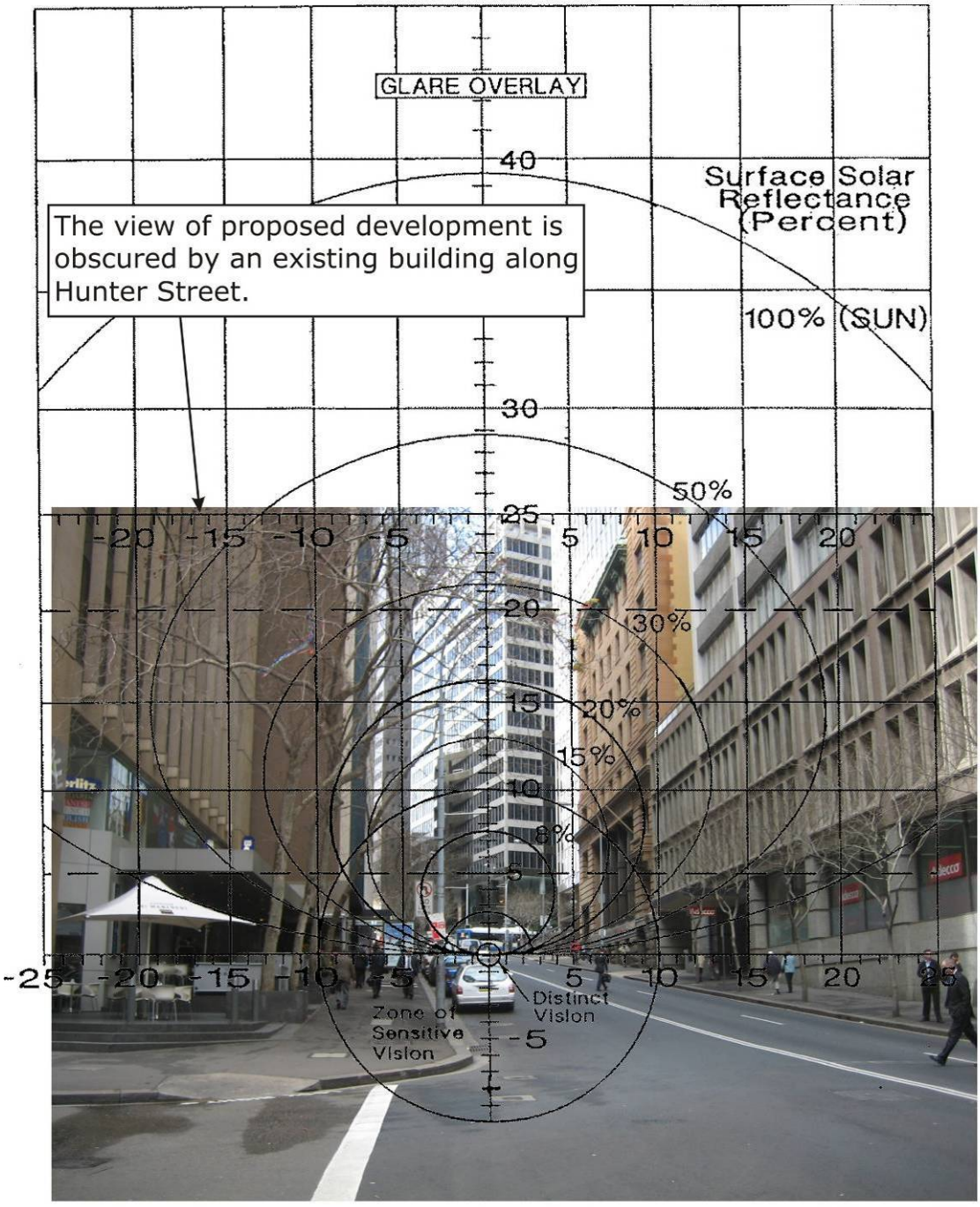

Figure A7: Glare Overlay for Point 7

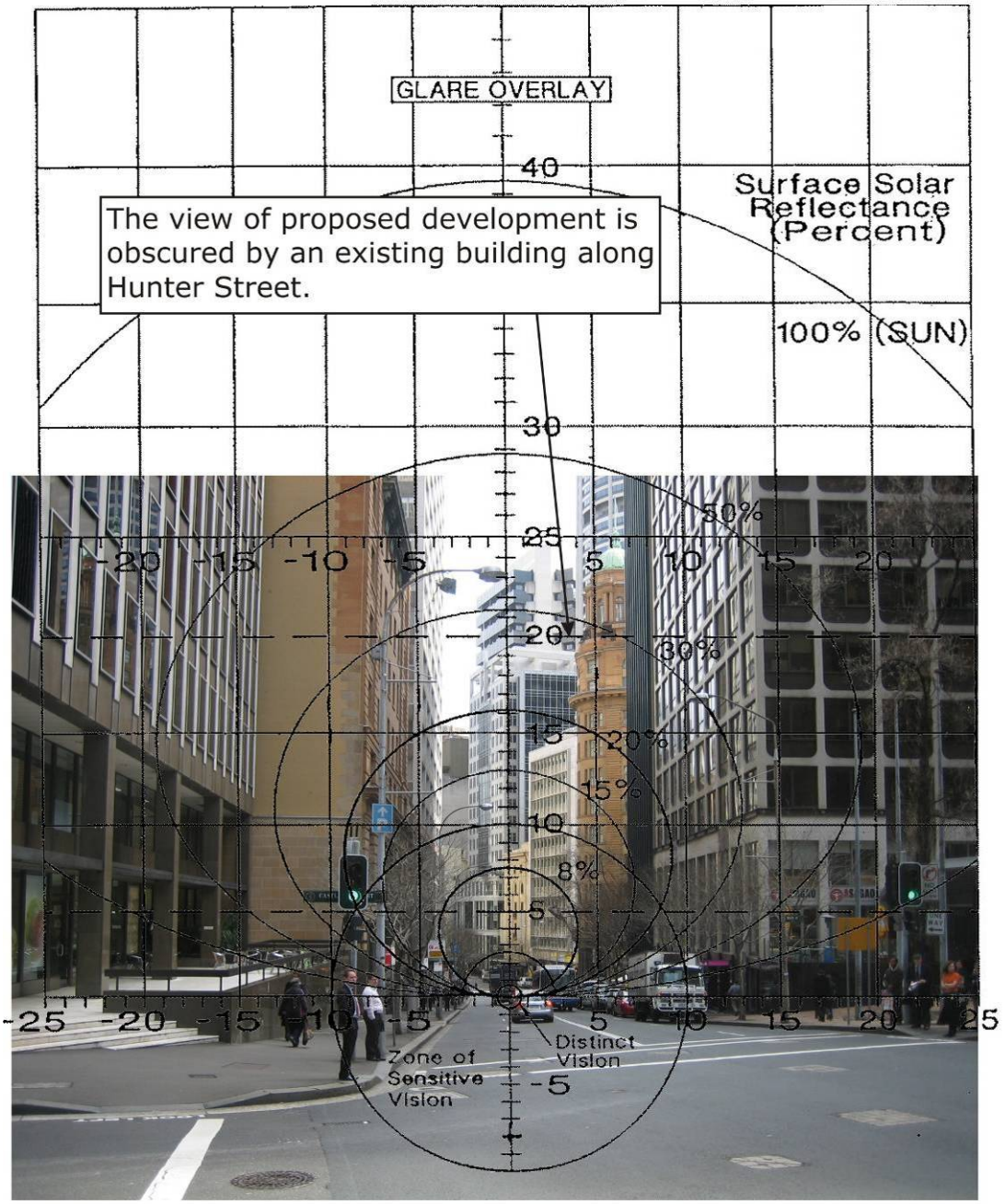

Figure A8: Glare Overlay for Point 8

Appendix B

Solar Charts for the Various Aspects of the Proposal

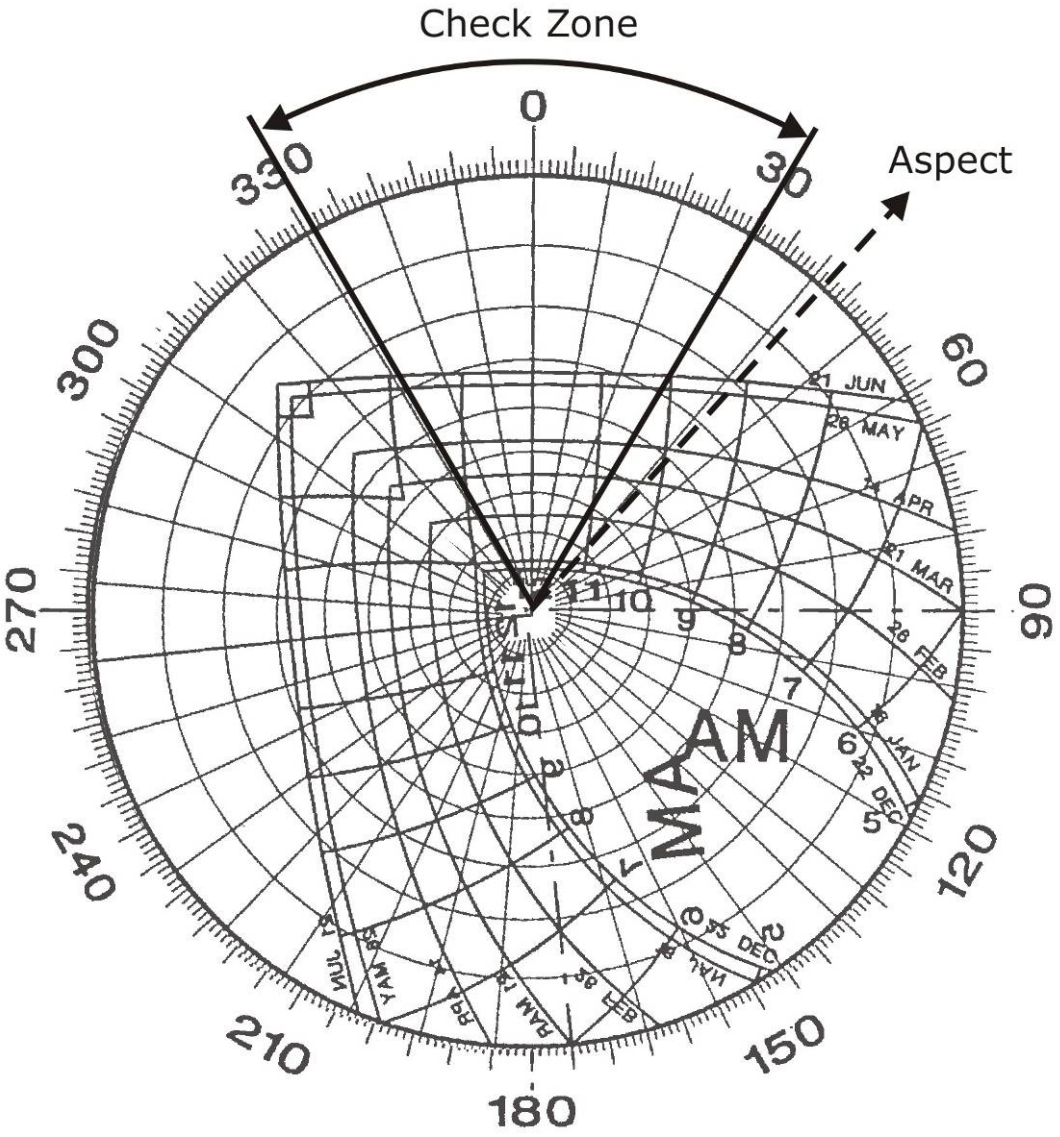

Figure B1: Sun Chart for Aspect 042°

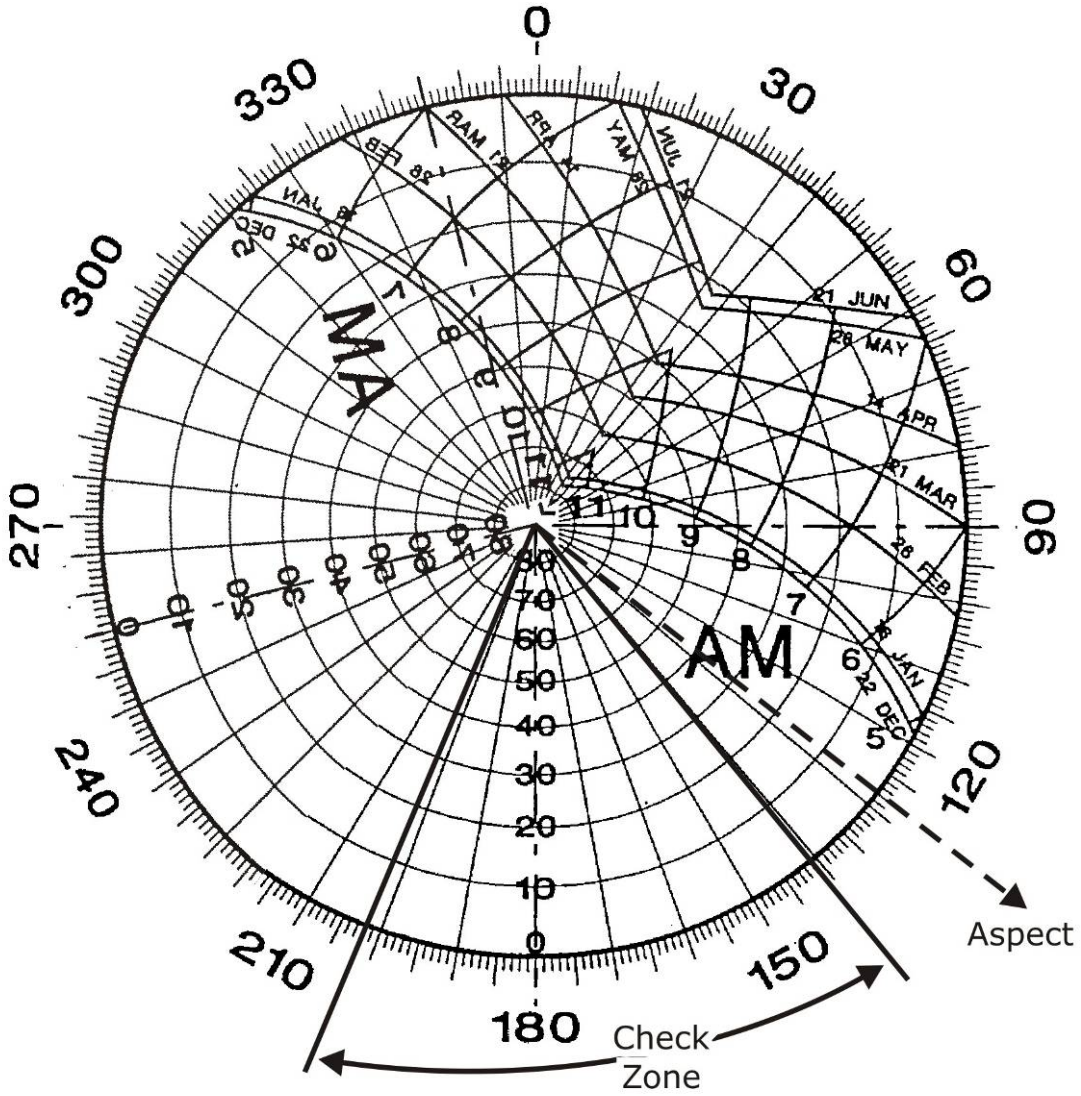

Figure B2: Sun Chart for Aspect 128°

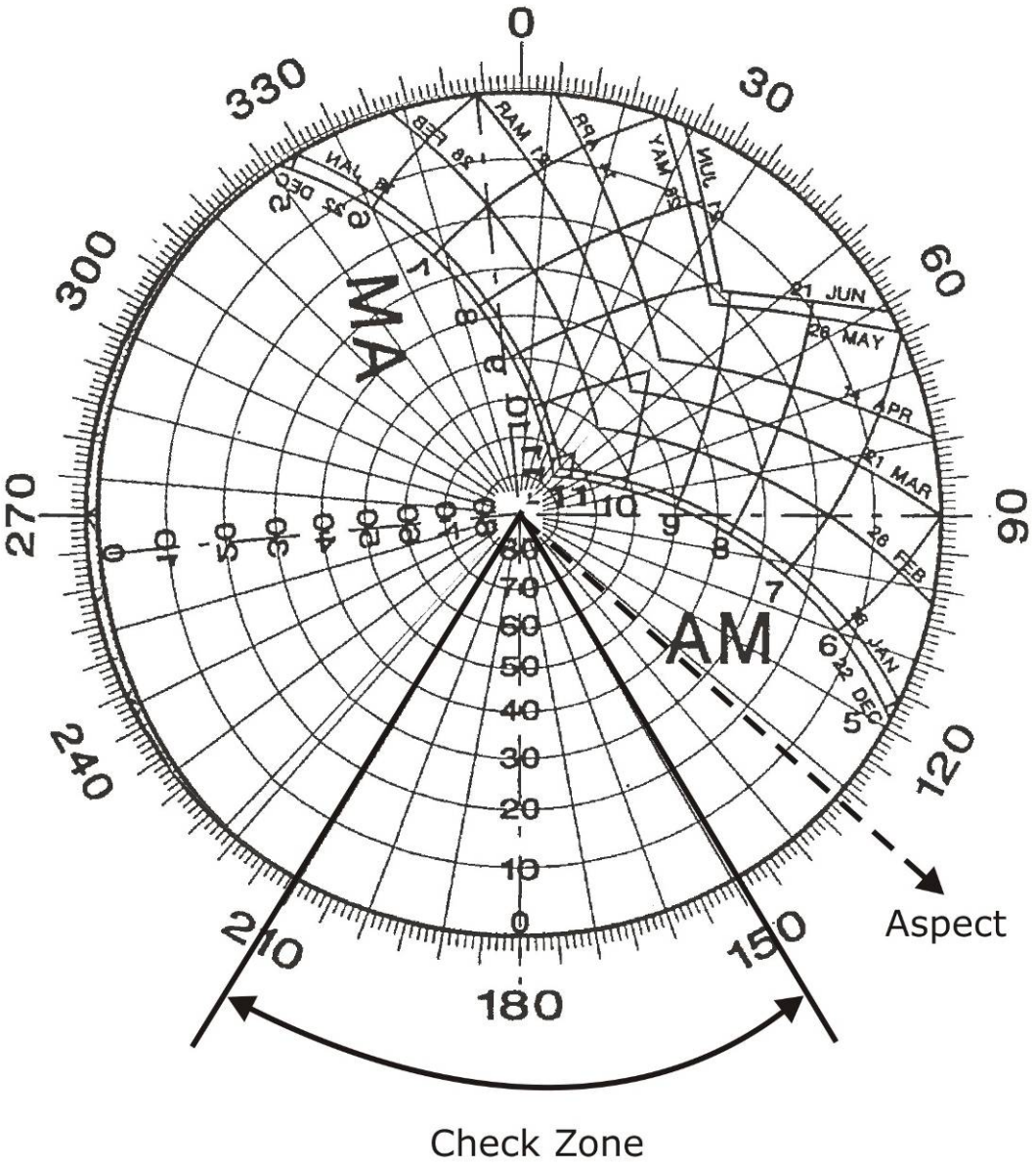

Figure B3: Sun Chart for Aspect 132°

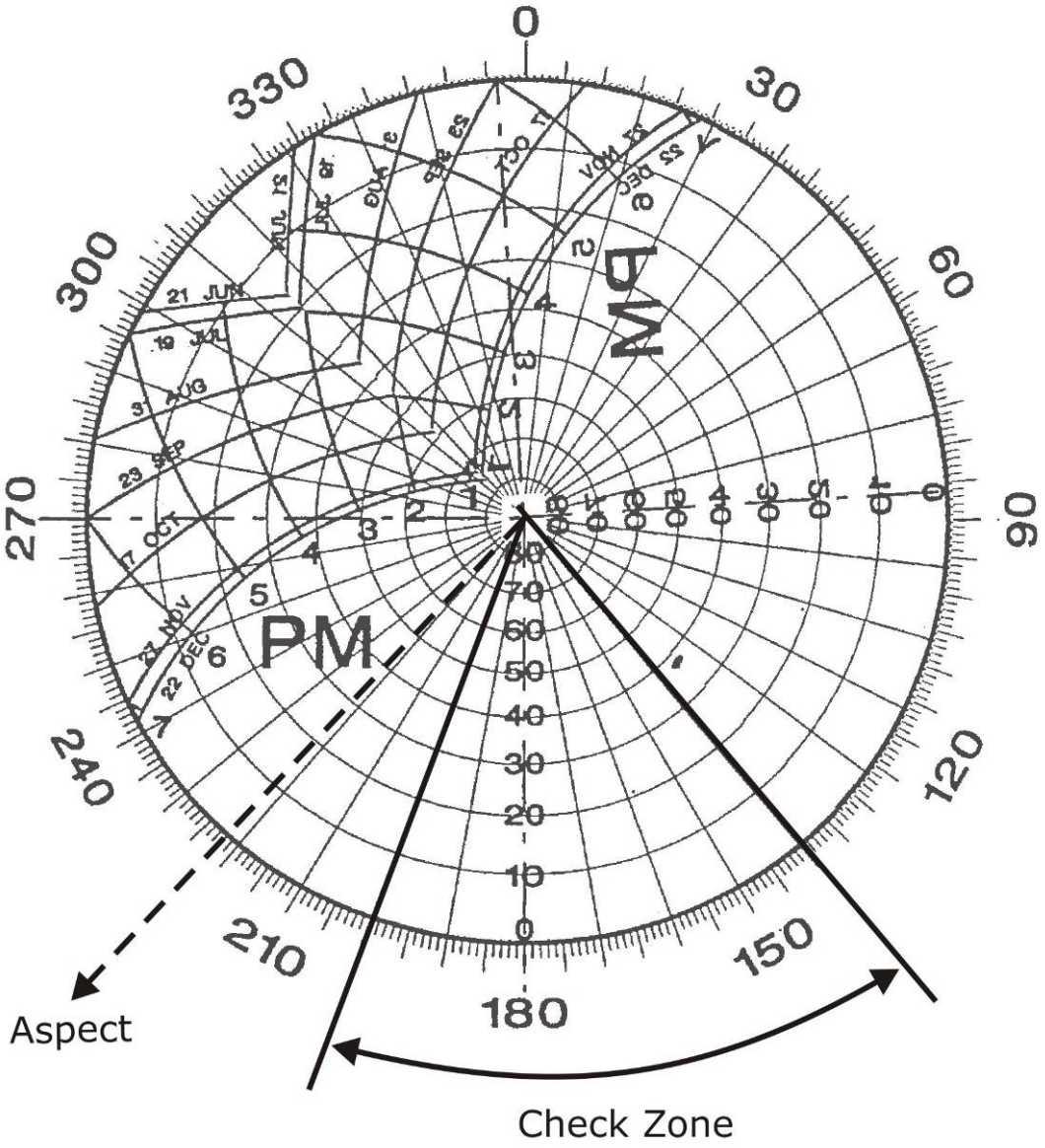

Figure B4: Sun Chart for Aspect 222°

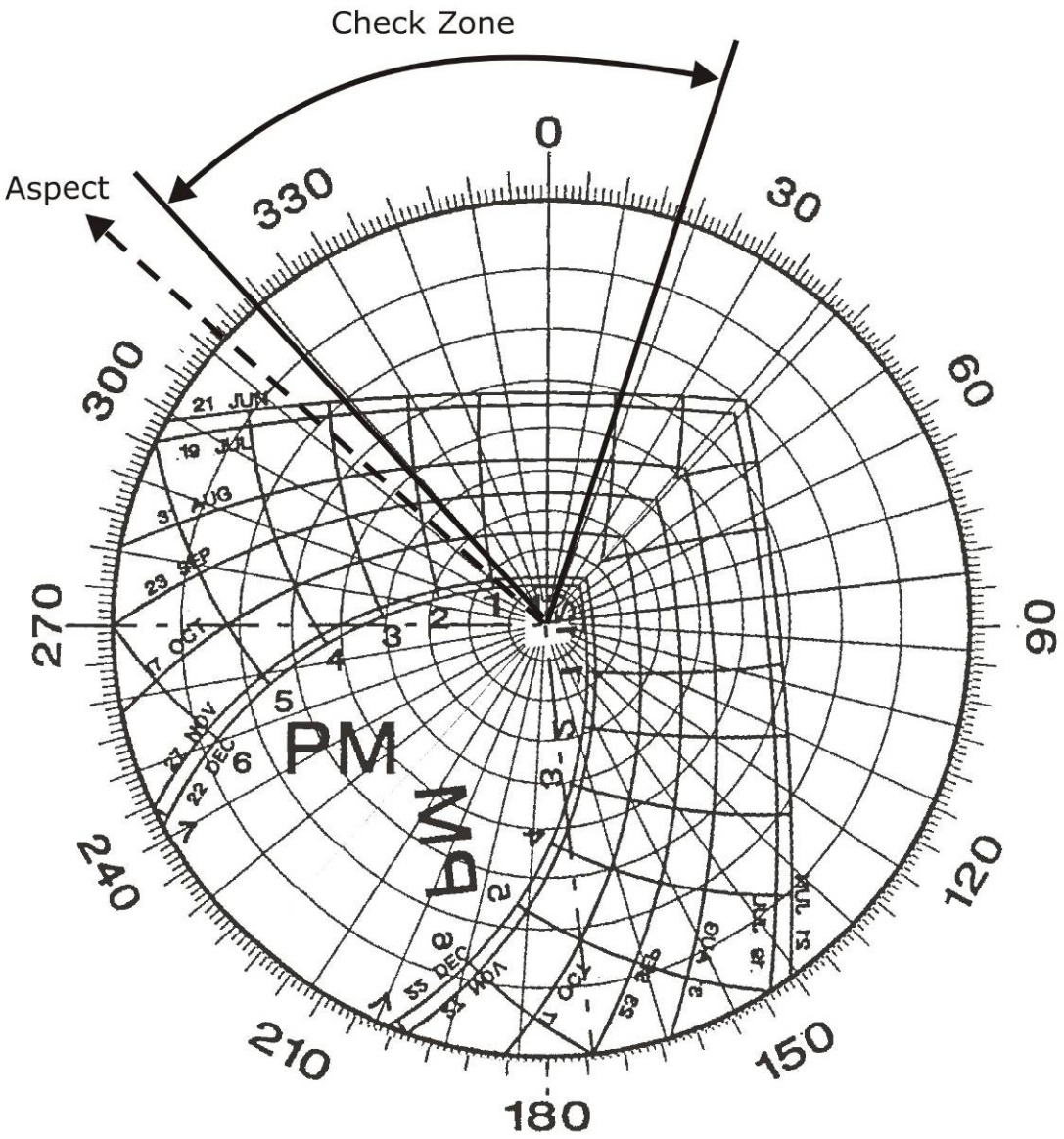

Figure B5: Sun Chart for Aspect 312°